The Chemical Age

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Contents

NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Dyestuffs Concentration Policy

THE announcement, which we have reason to think is well founded, that the British Dyestuffs Corporation is transferring its head offices from Spring Gardens, Manchester, to the works at Blackley, in pursuance of a considered policy of concentration, is very satisfactory from one point of view. It indicates that the Corporation is now working on a definite plan for the future and that a policy of concentration will gradually be applied for the purpose of bringing all the operations of the company under direct centralised control. This policy, we believe, will be generally endorsed as the one best fitted to effect economies in production and to improve the central oversight and co-ordination of all branches of the concern. The purely scientific and technical problems of production have been largely overcome. What is required to complete the success is good commercial organisation, which naturally includes economical production, and the Corporation, in adopting the policy of concentration, is acting in conformity with the best modern commercial experience, and taking a course that will be generally endorsed. Unfortunately, where scattered and proportionately costly units have to be collected to one or two main centres, changes have necessarily to be made, but they will be effected gradually and, we believe, with every consideration that is possible in such circumstances for personal interests.

As regards details, though no official intimation has been made, it appears that the transfer of the head offices from Manchester to the Blackley works is a first step towards unity and directness of control. The ultimate aim is to have all the Corporation's operations grouped at two centres—the Dalton works at Huddersfield and the Blackley works outside Manchester. At present the Corporation has five works, and the policy of concentration would mean the gradual elimination of three—the indigo works at Ellesmere Port and the dyestuff works at Clayton and Turnbridge. Some time must elapse before these changes can be effected, but it is satisfactory to find that the Corporation has a definite plan and objective for the future, and intends to move steadily towards it.

One of the chief remaining problems is that of price, and in this matter continued progress is being made. It is estimated that in the last year, as the result of improvements in administration and technical economies, a weighted average reduction has been effected in dyestuff prices of about 5d. per lb. It is a matter for regret that at this stage the coal strike should have intervened to check progress. Up to recently production has not been greatly curtailed, but we understand that on Monday the Huddersfield works were closed and that the Ellesmere Port indigo works are also closed. The Corporation, in this respect, is only suffering in common with all industry, and when a settlement of the coal dispute comes it is as likely as any to pick up quickly, especially if the expected boom in trade takes place.

Almost concurrently with these prospective developments of policy comes the announcement that the directors of the Corporation have decided to declare a dividend of 2½ per cent. on the ordinary capital for the year ended March 31. This is the first dividend to be declared on the recognised capital following the reconstruction scheme of last November, and it will have the effect of confirming the growing public confidence in the new management. It is, as *The Times* puts it, "of good augury." For the 17 months ended March 31, 1925, the Corporation showed a trading profit of £88,674. This reduced the debit to profit and loss to £360,602, and the debit was subsequently extinguished under the scheme of reconstruction. That scheme also involved the cancellation of the Government's holding of 850,000 Preference and 850,000 Preferred Ordinary shares in the company and the termination of Government control over the undertaking. The dividend is payable on the new Ordinary capital of £4,775,580, which replaced the previous issued capital of £9,197,112 in preference, preferred, and deferred shares.

Chemists and Corrosion

ATTENTION has already been drawn, in reference to the Congress of Chemists to be held in London during July, to the important conferences on matters of great industrial importance which are being arranged. A typical example is the symposium on "Corrosion," which is fixed for Tuesday, July 20. This is being arranged jointly by the British Chemical Plant Manufacturers' Association, the Institute of Metals, the Institution of Chemical Engineers, and the Chemical Engineering Group. The costly effects of corrosion in every branch of engineering, and especially in chemical and gas works, are known to every constructional engineer and works manager, and if the chemist and metallurgist between them can remove them, they will be conferring a lasting benefit on British industry. What British research has already done, and is still attempting to do, will be explained by a group of recognised authorities, including Mr. Ulick R. Evans, who will deal with "The Fundamental Principles of Corrosion"; Mr. P. Parrish, who will speak on "Corrosion and Erosion"; and Dr. W. H. Hatfield and Messrs. T. G. Elliott and G. B. Willey, who will discuss "Chemically Resistant Steels." It will be obvious that the problem is being attacked by men of considerable experience in the subjects involved, and this symposium will be of outstanding interest to chemists, chemical engineers, and the industry generally.

Possibly in no branch of metallurgy has there been such great advancement, both during and since the war years, as in connection with the production of chemically resistant steels and acid-resisting irons. The introduction of novel methods of manufacture and the addition of some of the newer and less common metals to iron and steel have produced alloys of a chemical resistance quite unprecedented. The steels produced to-day to withstand corrosion are far in advance of the earlier forms of stainless steels, which are chiefly martensitic. The newer corrosion-resisting steels are austenitic, i.e., they are softened by quenching from a high temperature, as in the case of manganese steel, whilst the acid-resisting irons have been also greatly improved recently, both from the point of view of homogeneity and toughness, as the result of careful methods of heat treatment. The symposium may reasonably be expected to yield some welcome evidence for industrialists of the progress made in this field.

The Fixing of Sulphate Prices

THERE is an impression in many quarters, due largely to reports emanating from the United States, that at the recent conference at Biarritz organised by the British Sulphate of Ammonia Federation and the German Potash Syndicate, a general price agreement for sulphate of ammonia was arranged. We believe that there is no real foundation for this report. The Biarritz conference was devoted solely to propaganda —that is, to the discovery of new fields for the profitable application of the ever increasing output of sulphate of ammonia, and so far as we are aware there is no intention at present to attempt the fixing of any general standard of prices. Nor, according to the available information, is the forthcoming conference in London in any way connected with the Biarritz conference.

American opinion has been rather disturbed by the presence of United States representatives at a conference of European fertiliser interests. In the belief —which, as stated, we believe to be erroneous—that "a working price basis was determined at Biarritz," our alert commercial contemporary of New York, *Chemical Markets*, has the following note on the subject, which may be interesting as an indication of the current American attitude: "We in the United States do not appreciate fully the significance of these changes nor do we realise fully the effects of the Biarritz negotiations. Our domestic consumption of ammonia is greater than any other nation; but it is more and more plain that the final outlet for the surplus must be through conversion into the sulphate. Within the past year, Germany has increased her ammonium sulphate exports to the astonishing total of 344,000 tons, over and above reparation deliveries to France. British exports totalled 262,000 tons. In the battle for markets, the world export price has dropped in two years $20.00 a ton, and the price next season will represent a further cut of at least 10 per cent. It is true, as Dr. Bueb pointed out, that ammonium nitrogen is not able completely to replace nitrate nitrogen, but it is also true that the increased output of sulphate and the development of other nitrogen bearing fertiliser materials, such as urea, calcium nitrate, ammonium nitrate, ammonium phosphate, and leunasaltpetre, will supply the world with fertilisers which will be found particularly useful for certain crop or soil conditions. All of this is a serious threat against the Chilean industry, and within this year their stocks have increased 393,000 tons. To maintain their sales at the 2,000,000 ton level, it is estimated in England that the price will have to be lowered $10.00 a ton—a cut that could hardly be borne without some relief from the export duties collected by the Chilean Government. We have here another triumph of chemistry over Nature, and its far-reaching result, so satisfactory to the American farmer, is to be commended to the attention of our Secretary of Commerce."

Significance of I.G. Developments

IN last week's issue of THE CHEMICAL AGE an account was given of the recent growth of the German chemical trust known as the I.G. Farbenindustrie Aktiengesellschaft, and in the present number further details of these developments appear. For the moment, the matter need not be discussed at length, though later perhaps some attempt may be made to analyse the economic causes behind these developments. But it is not too bold a suggestion that the sponsors of the I.G. aim at nothing less than the unification, under one direction, of the whole German chemical industry. Moreover, their interpretation of the term "chemical" appears to be so wide that it would not be surprising if even now the development of the I.G. is far from ended, and that the minds behind it already conceive of a unification of almost the whole of German industry.

Apart from its intrinsic interest, this matter deserves attention for a special reason—that is, the present

crisis in the British coal industry. The proposed Government action in the matter goes in two directions: firstly, an Eight Hours Bill; and, secondly, the Mining Industry Bill, which was read for a second time on Wednesday, and which proposes to carry out the most immediately practicable of the Royal Commission's proposals, such as the amalgamation of colliery undertakings, and other things. In this connection Sir Alfred Mond has repeatedly urged, among other terms on which the coal strike might be settled, compulsory co-operative selling. "Regulation of production to consumption, stabilisation of prices, both for export and inland sales," he suggests, "would enable a standard of prices to be set up on which the question of hours and wages could be logically based. It will be possible to arrive at some arrangement with our chief competitors regarding the export trade. In fact, I have personally received intimation to this effect from most influential sources connected with the German coal industry." Further, he states—and this seems to us important—"I have frequently pointed out that the creation of selling organisations is only one aspect of the problem; reorganisation should automatically follow it and cannot be left out of sight." From this it would seem that fundamentally the causes that have led to the coal crisis in this country and to the formation and development of the I.G. in Germany are the same. Whether we agree with the method of "trustification" or no, it would be well to follow carefully the trend of events in Germany. It is clear that in the creation of the I.G., and in the manner of its development, an economic experiment is proceeding on the grand scale, which, if it succeeds, may be a turning point in the world's industrial history.

Alkali Works Review

THE annual report for 1925 of the Chief Inspectors of Alkali Works, a summary of which is published in this issue, reveals a decrease in the works registered from 1,210 to 1,177, while the number of separate processes of manufacture under inspection is 1,928, as compared with 1,990. The total output of sulphate of ammonia for England and Wales was 350,612 tons, as compared with 362,180 tons in 1924. The tar distilled at gas and coke oven works amounted to 1,490,521 tons, and the pitch produced to 461,241 tons.

The report of Dr. Lewis Bailey, as will be seen, covers the industry exhaustively, and it is only possible here to note a few of its numerous points. It is satisfactory, once more, to observe the inspectors' gratification at the foresight displayed throughout the chemical industry, not only in the working of plant under the best possible conditions, having regard to the circumstances, but also in the vision of future possible developments in new directions. It is a healthy sign, the chief inspector remarks, when manufacturers are no longer content to work their plant in routine fashion, but turn their attention to such problems as the possibility of their more efficient and more economical operation and whether the type of plant employed in the past may not with advantage be modified or even superseded by a new plant.

In the alkali and copper wet process works control of operations is described as distinctly satisfactory, and there has been increased attention to detail, which makes for good in every respect.

As regards smelting works, the inspectors note with satisfaction a considerable advance in the treatment of acid gases given off in the calcination of sulphide ores About half the sulphuric acid chamber plants now work with a chamber space of less than 15 c. ft. per pound of sulphur burnt per twenty-four hours, while 9 c. ft. is quite common. With the newer types, it is stated, consistently good results are obtained with half this available space.

The water scrubbing of Gay Lussac tower exit gases has been abandoned at a number of works after short trial, but, the inspectors add, the trials had been made with towers that had been for long in use, and were consequently contaminated with considerable quantities of arsenical and other impurities. In the sulphuric acid (Class II.) works modifications continue to be introduced in concentration plant of the Kessler type. Contact plants for the manufacture of oleum are reported to have worked well. Superphosphate production in this country is still at a very low level, but such works as have operated have carried on the work satisfactorily.

Under the head of sulphide works it is reported that during the year the complete wet purification of coal gas has reached the trial stage on a working scale in this country, though not in its final form.

In the sulphate of ammonia and gas-liquor works the production of a high strength neutral sulphate has now become quite general. The ammonia plant effluent disposal difficulty continues to appear in fresh directions, and the inspectors' view is still that the problem must be tackled from the coal gas manufacture side. Instances are still found in tar works of pitch coolers needing attention, but on the whole recent years have seen a great improvement in this respect.

Books Received

THE CHEMICAL ENGINEERING LIBRARY.—SECOND SERIES. THE TRANSPORT AND HANDLING OF MINERAL ACIDS. By F. Hirsch. Pp. 140. 6s. MECHANICAL DRAUGHT. By J. E. Lister and C. Harman Harris. Pp. 138. 6s. London: Ernest Benn, Ltd.

TREMPE, RECUIT, CEMENTATION ET CONDITIONS D'EMPLOI DES ACIERS. By L. Grenet. Paris and Liége: Librairie Polytechnique Ch. Béranger. Pp. 656.

62ND ANNUAL REPORT ON ALKALI, ETC., WORKS. By the Chief Inspectors. Proceedings during the year 1925. London: H.M. Stationery Office. Pp. 31. 1s.

A TEXTBOOK OF INORGANIC CHEMISTRY. By Dr. Fritz Ephraim. English Edition by P. C. L. Thorne. London: Gurney and Jackson. Pp. 805. 28s.

THE PREPARATION AND ANALYSIS OF ORGANIC COMPOUNDS. By J. Bernard Coleman and Francis Arnall. London: J. and A. Churchill. Pp. 352. 15s.

The Calendar

July 19	Institution of Chemical Engineers: Fourth Annual Corporate Meeting.	Committee Room D, Central Hall, Westminster, London.
19	Institution of Chemical Engineers: Annual Dinner. 6.30 for 7 p.m.	Great Central Hotel, London.
19–23	Society of Chemical Industry. Annual meeting.	London.
Aug. 4–11	British Association for the Advancement of Science. Annual meeting.	Oxford.
Sept 20–24	Chemists' Exhibition.	St. Andrew's Hall, Glasgow.

Chief Inspector's Annual Report on Alkali Works

Review of Progress in Processes and Plant

The sixty-second Annual Report on Alkali Works by the Chief Inspectors for England and Wales and for Scotland (H.M. Stationery Office, pp. 31, 1s.) contains a careful review of the state of the industry during the year 1925. Below is given the substance of the report for England and Wales by Dr. T. Lewis Bailey. The volume also includes, in addition to the Scottish report by Mr. J. W. Young, an appendix dealing in detail with the interaction of oxides of nitrogen with arsenious acid and with sulphurous acid in the presence of sulphuric acid of varied strength.

THE total number of works registered was 1,177, which entailed the inspection of 1,928 separate processes; there was thus a reduction of 33 in the number of works, and of 62 in the number of processes as compared with the previous year. Four new works were found operating without having been registered: payment of back fees was made in each case.

The number of visits of inspection by the District Inspectors to registered works during the year was 3,956, in the course of which 2,679 quantitative estimations of the noxious constituents of chimney and other gases, escaping from the processes in operation, were made.

The number of complaints received from local authorities and private individuals alleging nuisance due to the escape of noxious gases from works was twenty-five, somewhat more than during the previous year; nevertheless, not excessive, especially considering that one-third of these related to processes that are not registrable under the Alkali Act.

There was one unusually serious case of nuisance, which was due to the emission of sulphuretted hydrogen from a registered works. It became a question whether legal proceedings should not be taken against the company; but on the whole it appeared that a severe warning by the Minister would meet the case. On representation being made to the company, steps were at once taken to reorganise the whole system, both as regards plant and the method of supervision.

In spite of poor conditions of trade generally, it is gratifying to see the foresight displayed throughout the chemical industry, not only in the working of plant under the best possible conditions, having regard to the circumstances, but also in the vision of future possible developments in new directions. It is a healthy sign when manufacturers are no longer content to work their plant in routine fashion, but turn their attention to such problems as the possibility of the more efficient and more economical operation of them; and, furthermore, whether the type of plant that has been employed in the past may not with advantage be modified, or even superseded by a new type.

Alkali and Copper (Wet Process) Works

Control of operations has been distinctly satisfactory, and there has been increased attention to detail which makes for good in every respect. By reason of the continued restricted use of cupreous pyrites throughout the country, there has been little activity generally at the wet copper extraction works.

Cement Works

The cement industry has been increasingly active, and this has entailed the installation of additional plant at existing works, and also the erection of several new works. Kilns of the rotary type are on the increase. The year has seen the erection of a factory for the manufacture of the new class of aluminous cement known as "ciment fondu," which is produced in molten condition in blast furnaces and subsequently ground. There has been no instance, during the year, of complaint arising from cement dust or kiln fume.

Smelting Works

It is very gratifying to be able to report a considerable advance in the treatment of the acid gases given off in the calcination of sulphide ores. There have been difficulties in connection with the satisfactory recovery of sulphuric acid from the products evolved in the roasting of zinc blende concentrates, but the problem has been so well tackled that acid plants are now operating very successfully, and the coming year will see further extension of this branch of work, so much to be desired. As Mr. Littlefield remarks in his district report, "it is not without heavy expense to the manufacturer, and much patient and highly skilled research work on the part of the technical management, that the processes referred to have been established."

Several instances of undue emission of sulphurous gases, during the calcination of arsenical sulphide ores, have this year claimed the special attention of the inspector in whose district they occurred: in such cases there would not appear to be any possibility of economic recovery of a by-product, and the problem resolves itself solely into one of obviating the possibility of nuisance. Co-operation of the works managers with the district inspector has been prompt and there has been every desire to ameliorate the conditions as rapidly as possible. There has been only one complaint from people resident in the neighbourhood of the works.

Increasing use is being made of the electrical deposition of smelting works fume; quite a number of such plants are at work, and they have proved their worth. According to P. E. Landolt, of the U.S. Research Corporation, efficiencies of 85–99 per cent. in the deposition of metallurgical fume and of 99 per cent. in the deposition of pyrites burner dust have been recorded on a number of installations in the United States.

Sulphuric Acid Works

About half the chamber plants of the country now work with a chamber space of less than 15 c. ft. per pound of sulphur burnt per twenty-four hours; 9 c. ft. is quite common, and with the newer types consistently good results are obtained with half this available space.

Cases of poisoning by nitrous gases during the repair of Gay Lussac towers have not yet entirely disappeared; one much regrets that it should be still necessary to call attention to the danger of exposure to these gases and to recapitulate the preventive measures that should be adopted, viz.:—

(*a*) Physical disconnection of the tower from all working plant.

(*b*) Washing of the tower with strong sulphuric acid in order to remove nitrous vitriol.

(*c*) Maintenance of effective *downward* draught, in order to remove noxious gases from the vicinity of those engaged on the work.

(*d*) The use of either a "breathing apparatus," enabling the person working in the tower to be provided with air from a source outside the tower and beyond the zone of danger, or a self-contained breathing apparatus, in which the workman carries the necessary supply of air or oxygen in a cylinder on his back.

Attention is directed to Nos. 6, 7 and 8 of the Chemical Regulations, 1922, under the Factory and Workshop Act, 1901. It has been considered advisable to issue a special circular, embodying the precautions set out above.

The recovery of sulphuric acid as a by-product has naturally an effect on its manufacture as a distinct and separate industry. One, therefore, expects modifications in the latter class of work, and the special features that appear likely to receive most attention in the near future are the intensive systems of manufacture, and a reduction of even the working losses, which in the past have been looked upon as small and inevitable. We have come to a period when the smallest details in a manufacturing process claim close attention. To mention only two points—the loss of a comparatively small proportion of sulphur even may be worth a good deal of consideration in a large works, if, as a result, it can be economically saved; the cause of the continual loss of nitre, looked upon as inevitable, is a point which has not been by any means completely solved, and such loss is by no means a constant factor for all works.

These are in themselves only small matters perhaps, but a number of small items, whether due to direct loss or to reducible working cost, become appreciable when added together; and even in the case of an old-established process it may be advisable to work critically through the whole process from beginning to end, examining every detail of every operation from a chemical and a financial aspect.

During the past year we have done a certain amount of work,

which has a bearing on the points mentioned, the work having been taken in hand, firstly, with a desire to ascertain what reactions take place when the exit gases from the Gay Lussac tower are scrubbed with a limited amount of water, as described in the Scottish section of the Annual Reports for 1923 and 1924, and, secondly, by reason of the considerable variations in the percentage of nitre actually used in different acid plants.

Water scrubbing of Gay Lussac tower exit gases has been abandoned at a number of works after short trial, but the trials had been made with towers that had long been used as Gay Lussac towers, and were consequently contaminated with considerable quantities of arsenical and other impurities; moreover, the acid content of the effluent, obtained during the water scrubbing, indicated undoubtedly that the tower packing still contained sulphuric acid, effluents varying as widely as 20° Tw. and 60° Tw. being obtained, whereas the best working would appear to demand not more than 7° Tw. or 8° Tw. It has been suggested that arsenical compounds may have, in presence of water or dilute sulphuric acid, a reducing action on nitrous acid, with possible production of N_2O or even nitrogen, and this has been given as a possible explanation of failure to obtain nitrous acid in the effluent from the water scrubbing in an old and dirty tower, whereas nitre is undoubtedly recoverable by water scrubbing in a freshly packed tower.

Our laboratory experiments, carried out over a wide range, show that reduction of nitrous acid by arsenious acid occurs to a limited extent only and very slowly, at any rate at the temperature prevailing in the process we are considering. Any possible action of ferrous salts and of selenium we have not investigated.

The effect of sulphuric acid of different strengths on nitrous acid is, however, illuminating. As ascertained by bubbling air through various strengths of sulphuric acid, containing always the same weight of nitrous acid, the loss of nitre (permanganate test) increased regularly until a sulphuric acid strength of about 100° Tw. was attained; at 135° Tw. it was negligible. There is formed the nitroso acid; this is decomposed by water, the more acid present the larger being the amount of nitroso acid to undergo decomposition; but when the strength of acid is over 115° Tw. the sulphuric acid exerts a stabilising effect, and loss rapidly ceases. Therefore, if nitre is to be retained in the effluent from a water scrubber, the acidity of this effluent must be kept especially low, not over, say, 8° Tw.

Addition of arsenious acid in these experiments did not indicate accelerated decomposition, time of contact being too short, but if the solution be allowed to stand for several days (with exclusion of air) slow action of the arsenious acid is indicated by gradual evolution of nitric oxide gas. Corresponding experiments with omissions of arsenious acid gave no gas under the same conditions.

We now pass to the action of SO_2 on nitrous acid (assuming air absent). If the SO_2 be in excess, reaction in presence of water is rapid, with formation of N_2O (but no NO), sulphuric acid and hydroxyazotised bodies. When the nitrous acid is in excess, the character of the reaction is determined by the strength of the sulphuric acid present, as indicated by the following facts:

(*a*) With acid of sp. gr. 1·225 (45° Tw.) the products of reaction are NO and H_2SO_4.

(*b*) With water only the products are N_2O and H_2SO_4.

(*c*) With acid of intermediate strength the products are N_2O, NO and H_2SO_4.

The most reasonable explanation of the phenomena appears to be in accordance with the views of Divers on the reactions in the chamber process, in which case the primary product of the reactions under discussion is "purple acid" ($H_2N_2SO_6$); this dissociates more or less completely in presence of water, giving H_2SO_4 and NO, which NO is capable of reduction by SO_2 existing locally in excess. Sulphuric acid, on the other hand, tends to stabilise the condensation product; hence, when acid is present, the figure for residual SO_2 is high.

Experiments carried out with a view to ascertaining the nature of the interaction of SO_2 and NO under a variety of conditions definitely established that,

(*a*) With acid of sp. gr. 1·2 (40° Tw.) and upwards, no noticeable reduction of the NO occurs;

(*b*) with acid of sp. gr. 1·07 (14° Tw.), slow reduction of NO takes place;

(*c*) with water only, as much N_2O is formed as corresponds to the SO_2 originally present. Reduction to nitrogen could not be established.

It would appear that the judicious use of a water scrubbing tower is capable of effecting useful work, after the strong acid wash of the Gay Lussac towers has performed its service; escaping SO_2 can be converted into H_2SO_4, but it must be remembered that the instability of nitrous acid is increased as the sulphuric acid strength increases (under the conditions being considered), and at the same time the action of SO_2 on the NO thereby produced is retarded, and so, if the acid in contact with the reacting gases be over, say, 8° Tw., the essential function of the water scrubber is prejudiced.

The maximum amount of nitre destroyed and lost as N_2O in the water scrubber cannot exceed what is equivalent to the SO_2 recovered as H_2SO_4, and there is the possibility of retaining in the weakly acid solution at any rate a proportion of the hitherto escaping nitrous gases.

André Graire (*Compt. rend.* 179, 1924, p. 397; and 181, 1925, p. 178) has published data which indicate that the chamber reactions are reversible and under certain conditions NO is capable of reducing H_2SO_4 with production of SO_2. This being so, we have an additional argument in favour of the use of a final water scrubber under the conditions already insisted on above.

There is a recent proposal to place the water scrubber between a small preliminary Gay Lussac tower and a final Gay Lussac tower, but, after what has been said above, a suggestion of this kind is difficult to justify.

Points that might be well worth consideration, in the light of our experiments, are the conditions existing in the neighbourhood of steam jets and water sprays in the chamber process, and the action of arsenical acid in a last chamber, where the strength of acid (90–95° Tw.) is in the neighbourhood of a critical strength as regards stability of nitrous acid and its reaction with As_2O_3.

Sulphuric Acid (Class II) Works

Modifications continue to be introduced in concentration plant of the Kessler type. Perrin and Duron plants have long been used, and more recently the Zahn modification has come in, the calottes in which and their turbinal supports are of special acid-resisting metal; a special feature is a channel between the acid inlet and acid outlet section of the saturex; the producer attached may be used with coal.

Contact plants for the manufacture of oleum have worked well. As has been remarked in former years, dust and acid mist are to be particularly guarded against if conversion is to be satisfactory. The dust difficulty is intensified where the acid is to be recovered as a by-product from metallurgical operations: electrical deposition of both dust and acid mist is almost essential in such case.

Chemical Manure Works

The production of superphosphate is still at a very low level, owing to the low price of imported superphosphate. Such works as have operated have carried on the operations satisfactorily, waste gases having been very efficiently treated.

Sulphide Works

The 75 works of this class have been on the whole well conducted. There was, however, one case of a serious nature, involving inconvenience to people in the district in which the works are situated. There were several contributing factors; the breakage of an underground foul-gas main and the flooding of the ground with water, occurring at the same time, prevented the noxious gases from reaching the tower provided for the absorption of sulphuretted hydrogen. The whole system has now been reorganised and the foul-gas main has been reconstructed above ground, so that leakage of gas can be at once located and the general condition of the main kept under observation.

During the year under review the wet purification of coal gas has reached trial on a working scale in this country, though not in its final form. The process in its latest form depends on the absorption of H_2S and HCN from crude coal gas by means of an alkaline solution, with recovery of sulphur, as such, in a subsidiary operation. The difficulty hitherto (and the objection to the introduction of the process in this country) has been the need of a method of economically recovering the sulphur, and it seems likely that this difficulty has now been overcome. To remove the H_2S from the wash solution and to

pass it into the air, or to burn it, would have been easy enough, but such pollution of the atmosphere as would result renders disposal methods of this kind out of the question.

Venetian Red Works

One new work gave rise to complaints by reason of the escape of acid fume at certain stages of the process. The working of the plant was investigated in detail by the District Inspector. As a result certain alterations were required, in order to ensure satisfactory absorption of the acid gases at all stages, and these alterations were promptly put in hand.

Arsenic Works

The number of these works operating was 33. The District Inspector found unduly heavy emission of oxide of arsenic from a chimney at one works. It transpired that a new furnace had been erected and was engaged on work of an experimental character, but the condensing arrangements proved to be inadequate for the quantity of material under treatment. Representations were made to the company and additions were immediately made to the plant, which had the effect of reducing the escape of this noxious constituent of the escaping gases to a satisfactory point. With this exception there has been no serious instance of excessive emission of arsenical fume from any of the works of this class.

With a low price for arsenic such as has recently prevailed, there is apt to be a tendency for those in charge of operation to be less particular as to completeness of deposition in the flues, but any such procedure cannot be countenanced. There is no serious difficulty in preventing the escape of oxide of arsenic, in more than very minute quantities, from either calcining or refining plants, and the conditions laid down in the past must be strictly adhered to.

Bisulphide of Carbon Works

The expansion of the artificial silk industry has been necessarily accompanied by an increase in the production of bisulphide of carbon. As a text-book process this manufacture has the appearance of being perfectly simple; nevertheless it presents a number of quite serious difficulties as regards both the manufacture of the crude product and its refining. Imperfectly made charcoal and other conditions may give rise to the formation of considerable quantities of sulphuretted hydrogen, which has to be dealt with in order to obviate atmospheric pollution. The usual methods of dealing with this are treatment in Claus kilns or absorption by means of oxide of iron. But the possibility of the formation of sulphuretted hydrogen in the first instance should be reduced to the lowest possible limit. Prevention is invariably to be preferred, so far as this can be attained: even partial prevention reduces the difficulty of the cure.

Sulphate of Ammonia and Gas-liquor Works

The production of a high strength neutral sulphate has now become quite general. The methods of dealing with the foul gases given off in the manufacture have undergone no change; the instances of inefficient supervision have been few. It has, however, been necessary at several works to press for reconstruction of purifier floors. There is always possibility of the cracking of such floors after prolonged use, and this point should always be borne in mind, for sulphuretted hydrogen, passing through cracks in the purifier floors, may travel considerable distances below ground before making itself manifest.

The ammonia plant effluent disposal difficulty continues to obtrude itself in fresh directions and it is more and more apparent that the problem must be tackled from the coal gas manufacturing side, as was previously pointed out in the 61st Annual Report, 1914, p. 11. It is gratifying to see that more than one gasworks manager has of late been working on the lines suggested, and with promising results. From the laboratory side we have little to add this year.

Tar Works

Instances are still found of pitch coolers needing attention but, on the whole, recent years have seen a great improvement in this respect, due to the activities of the District Inspectors. Few complaints have been alleged this year against tar works. Such as were received related to minor incidents of short duration. The adoption of a manhole cover, with pitch-cock attached, at the bottom of tar stills, as referred to in the 61st Annual Report, 1924, p. 10, is extending. Special thanks are due to Mr. E. Linder for the way in which he has carried out the intricate details of the works on nitrous acid, described in the appendix to the report.

I.—Number of Works Registered.

	1925.	1924.	1923.
Alkali works	47	48	52
Scheduled and other works	1,130	1,162	1,167
Total	1,177	1,210	1,219

Number of Separate Processes of Manufacture under Inspection.

	1925.	1924.	1923.
Total	1,928	1,990	1,995

II.—Average Amounts of Acid Gases Escaping.
Expressed as Grains per Cubic Foot.

	General Average.		
	1925.	1924.	1923.
1. *Muriatic Acid:*			
Condensed in alkali works per cent.	98·7	98·7	98·6
In gases of chimney or final outlet:—			
(i) Alkali and Copper (wet process) works	0·064	0·068	0·073
(ii) Salt works	0·045	0·043	0·036
2. *Acidities of Chimney and Other Gases in terms of* SO_3:			
Escaping from sulphuric acid chambers	1·05	1·09	1·10
Final outlets from sulphuric acid concentration processes	0·64	0·67	0·75
Chimneys of smelting works	2·68	3·73	3·33
Chimneys of other works	0·67	0·76	0·72
All chimneys	0·93	1·22	1·10
3. *Condensers of Chemical Manure Works:*			
(SO_3 equivalent of H_2SiF_6)	0·06	0·08	0·07

III.—Amount of Ammonia Products Manufactured in 1925
Expressed as Sulphate (25¾ per cent. NH_3)—Tons.

From Liquor Produced in:	1925.	1924.	1923.
Gasworks	148,945	151,161	142,980
Other Works (including Coke Ovens, Ironworks, Producer Gas, Synthetic, etc.)	201,667	211,019	185,106
Total	350,612	362,180	327,996

Note.—Of the total quantity of ammonia products, the equivalent of 31,581 tons was manufactured as concentrated ammoniacal liquor; the balance of 319,031 tons consisted of other ammonia products (sulphate, chloride, nitrate, etc.).

Amount of Tar Products Manufactured in 1925.

	Gas and Coke Oven Works. tons.	Other Works. tons.
Tar distilled	1,490,521	10,145
Pitch produced	461,241	4,312

Institute of Chemistry Examinations

The following are the results of the April-May examinations:

Pass List.

Examination for the Associateship in General Chemistry.—Edward John Bond, B.Sc.(Lond.), West Ham Municipal College; Richard Parkinson Bothamley, B.Sc.(Lond.), University College, Nottingham; Frank Bourne, The Technical College, Loughborough; Joe Harrop Coucill, A.M.C.T., Manchester College of Technology; Wilfred Farrand Elvidge, B.Sc.(Lond.), University College, Nottingham; Ida Mary Groves, B.Sc.(Birm.), The University, Birmingham; Charles Royston Henshaw, A.M.C.T., Manchester College of Technology; Duncan McRobert Massie, A.M.C.T., Royal Technical College, Salford, and Manchester College of Technology; Eric Reid, Liverpool Central Technical School.

Examination for the Fellowship.—In Branch A—Inorganic Chemistry, Section II—Metallurgy: Charles Forrester. In Branch B—Physical Chemistry: Laurence James Patrick Byrne, B.Sc.(Birm.); Clifford William Herd, B.Sc.(Lond.). In Branch E—The Chemistry (including Microscopy) of Foods and Drugs, and of Water: Frederick Grant Duncan Chalmers, M.A., B.Sc.(Aberd.); James Ross Fraser, A.C.G.F.C., B.Sc.(Lond.); William Plenderleith Lewellen Hope, B.Sc.(Edin.); Cecil John House, A.R.C.S., B.Sc.(Lond.); John Brown McKean; Oswald James Walter Napier, M.A.(Cantab.). In Branch F—Biochemistry: Major Thomas Crawford Boyd, I.M.S., F.R.C.S., L.R.C.P. (Ireland), D.P.H.

Modern Devices for Power Plant Control

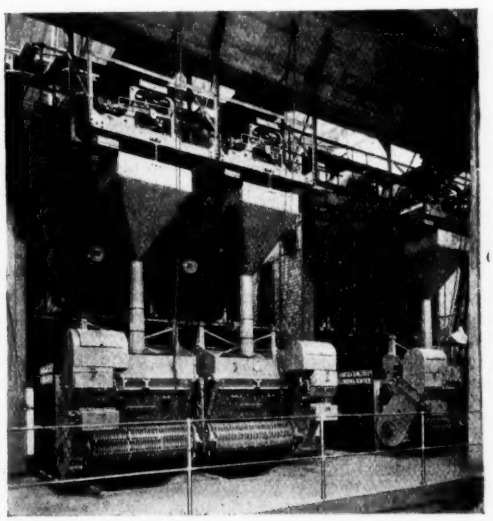
Notes on Various Types of Apparatus

In view of the importance of the conservation of power in works, and of obtaining accurate data for costing, we give below notes on various types of apparatus more or less applicable to these purposes.

Modern Boiler Houses

For all industries where power or process steam is required, the boiler house of to-day is a particularly important section of the works. The continually advancing price of fuel demands a maximum economy of operation, and at the same time an adequate supply of steam under all conditions of load, together with continuous reliability, is an essential condition of modern practice. It is for this obvious reason that the present-day factory is so well equipped as regards steam-raising appliances. The illustration shows a typically modern lay-out as adopted by many industrial firms, the particular plant in question being installed at one of the Northern collieries. It consists of two Babcock and Wilcox water-tube boilers set in battery, each boiler being capable of evaporating 25,000 lb. of water per hour, and working at a pressure of 200 lb. per sq. in. These boilers are equipped with Babcock mechanical chain grate stokers, the fuel being automatically fed into the stoker hoppers from overhead coal bunkers. The boilers are of the standard Babcock land type with integral superheaters, and these, together with the chain grate stokers, are sufficiently familiar to most engineers to need little further description.

Special attention may, however, be directed to the Babcock patent traversing coal chutes which, by automatically spreading the slack coal evenly over the stoker hopper, ensure an even fuel-bed in the furnace and contribute to a maximum



TWO BABCOCK AND WILCOX BOILERS FITTED WITH SUPERHEATERS, CHAIN GRATE STOKERS WITH TRAVERSING CHUTES AND DIAMOND SOOT BLOWERS.

combustion efficiency. The method of operation is extremely simple. A coarse pitch thread is turned on a shaft extending the full width of the grate. In the tail of each chute—which is free to move at its upper end—is bolted a large " nut " through which the threaded shaft passes. The shaft is driven from the stoker driving gear, the speed varying with the speed of the grate.

Another aid to efficiency on the plant in question is the Babcock calorised diamond soot blower, which during recent years has almost become standard with modern installations. The old process of " blowing down " the tubes by means of a hand lance necessitates a considerable amount of overtime, and, being in many respects a " nasty " job, depends for its effectiveness rather too much on the human element. With the automatic blowers it is possible to soot down a boiler completely while it is at work, in a few minutes, thirty seconds being sufficient for the operation of each blower head. With this apparatus it has been found that the temperature of the exit gases from the boiler can be maintained over very long periods at a practically constant figure. The effect of this over a period increasing the running efficiency will be appreciated by all combustion engineers.

Full details of the apparatus, which is steam operated, may be obtained from Babcock and Wilcox, Ltd., on application to their chief office at Babcock House, Farringdon Street, London, E.C.

A Simplicity Steam Trap

Most positive action steam traps have quite a number of working and wearing parts such as valves, valve seats, levers, fulcrum, etc., all of which are more or less liable to stick and, being subject to corrosion, require a good deal of supervision and fairly frequent renewal. In the simplicity trap, produced by the Key Engineering Co., while retaining the advantages of positive action over indirect thermostatic control, practically all moving and wearing parts have been eliminated. The only moving part is a hollow seamless ball, which floats freely in the condensate : this acts both as float control and as valve and, as it is floating, it constantly offers a new surface to the discharge orifice face, which is a plane surface acting as valve seat, and on which it has a rolling (not rubbing) motion. The only surface therefore liable to wear is that of the discharge orifice and this is fitted with a special alloy centre, which, after years of trial, has shown itself to be practically proof against the wire drawing effect of the issuing water. The working steam pressure holds the ball against the discharge orifice until sufficient condensate has flowed into the trap body to raise the water level well above the discharge orifice, when the buoyancy of the ball will be sufficient to counteract the holding pressure of the steam and it will roll upwards, disclosing the orifice and allowing the condensate to be discharged. As the dimensions, etc., of the ball are such that this rolling upwards does not take place till the condensate is above the orifice level, there is always a water seal between the live steam and the opened discharge.

The first of these traps was supplied about three years ago to an electricity supply station near Manchester and, although it has been in constant service, it has not required any renewals of parts yet. In fact, although there are now a very large number of these traps in service and many of them have been working two to three years, the firm have not yet had any appreciable demand for replacement balls or orifices, which are of course the only two parts which would ever need to be replaced.

Works Control Instruments

A complete range of industrial instruments for application to all classes of power plants is produced by Electroflo Meters Co., Ltd., of Abbey Road, Park Royal, London, N.W.10. These instruments comprise " Electroflo " (electrically actuated) meters for the measurement of the flow of steam, water, air, oil and gas ; draught and pressure indicators and recorders ; CO_2 indicators and recorders ; indicating and recording single, duplex and multi-point type pyrometers, thermometers, etc. In the construction of the " Electroflo " meter, all mechanisms and moving parts have been eliminated, whilst independently functioning electrical instruments are employed for the purposes of indicating, recording and integrating the rate, characteristics, and quantity of the flow. " Electroflo " draught indicators have a simple operating principle, clear visibility, and sensitive reading. The dials are 12 in. in diameter and the instruments read in 1/100 in. w.g.

In " Electroflo " CO_2, indicators and recorders, both chemical and combined chemical and electrical types, special points are complete absence of all glassware and fragile materials, clearly visible indicating dials and wide recording charts. The instruments are totally enclosed in metal cases complete with padlocks and are therefore foolproof. The " Electroflo " high resistance distance indicating pyrometer is claimed to have the highest internal resistance of any

pyrometer on the market. Its accuracy is independent of the length of leads between thermocouples and instrument, and of atmospheric changes in temperature around the instrument or along the wiring. The company is interested in the production of accurate and reliable metering and measuring devices for all industrial and public utility power plant requirements, and the solution of power control and measurement problems. Particular attention is given to the study of the measurement of distributed steam and water in industrial power plants, as a basis for the institution of cost accounting systems.

A Rotary Sugar Beet Dryer

The following illustration shows a very large rotary drying machine, leaving the works of Manlove, Alliott and Co., Ltd., at Bloomsgrove, Nottingham, for the sugar beet factory at Felstead, Essex. This rotary dryer is some 7 ft. diameter by 33 ft. long, weighing over 17 tons, and is to be used for drying

the pulp after the juice has been extracted from the raw sugar beet. The firm are large makers of this class of machinery and in addition to a big order for beet pulp dryers they have supplied sugar beet dryers to most of the beet sugar factories erected or being erected in this country, entailing a considerable amount of employment to the engineering trade in Nottingham.

Electrical Thermometers and Pyrometers

Electrical methods of measuring temperature are extensively adopted in modern industrial processes, not only because of the great accuracy of electrical thermometers and pyrometers, but also on account of the ease with which indications of temperatures at a number of distant points can be recorded at one central position. The indicator can be installed, for instance, in the manager's office and can be connected by the operation of a switch to thermometers in different parts of the establishment.

In their new list No. T6, Negretti and Zambra, Ltd., 38, Holborn Viaduct, London, give full technical descriptions and commercial information regarding six main types of enclosed electrical thermometers covering all temperatures between 270 deg. F. and 3,000 deg. F. For indicating temperatures in power plants, cold storage rooms and the like, resistance type thermometers are recommended, this type being suitable for temperatures from 270 to 500 deg. F. Thermo-couple instruments using base metals may be used for temperatures between 150 and 1,500 deg. F. and are employed in annealing and tempering ovens and for measuring the temperatures of flue gases. For still higher temperatures, such as those in hot blast mains, hardening furnaces and so forth, a nickel-chrome thermo-couple should be employed, while rare metal thermo-couples are necessary for temperatures up to 3,000 deg. F. in such positions as furnaces and pottery kilns. Instruments with two scales and two ranges covering temperatures from 20 to 1,500 deg. F. combine a resistance element and a thermo-couple and may be employed for recording the temperatures of feed water and superheated steam or flue gases. The catalogue includes illustrations and details of the thermometer units, electrical indicators, and the necessary switches, connecting leads and other accessories.

Automatic Pressure Regulator

The "Reineke" automatic pressure regulator, for the control of gas pressures or vacua between zero and 20 inches of water, is supplied by Huntington, Heberlein and Co., Ltd., of 47-51, King William Street, London, E.C.4. In the utilisation of blast-furnace and coke-oven gas, in particular, it is essential to regulate carefully the pressure on the gas supply if the highest thermal efficiency is to be secured. By means of this regulator the pressure can be maintained within 1/50 in. W.G. of any desired limit, and the twin motors operating the regulator can be supplied suitable for A.C. or D.C. circuits. These motors are totally enclosed, and other mechanical gear is totally immersed in an oil bath contained in a dust-proof housing. The regulator can be fitted with a simple device by which, in the event of the gas supply failing, the damper is automatically closed, thus eliminating any danger of back-firing or explosion. The twin motors are connected through combination wheels to differential gearing. Any variation in the gas pressure causes a float to rise or fall, and this operates the contact gear controlling the motors. With variation in speed of either motor, two idler pinions commence to roll and alter their radial position in the requisite direction around the central axis of the main shaft, this motion being transmitted by a worm and worm-wheel to a throttle disc in the gas main. The supply of gas is thus controlled and the pressure maintained at the desired value.

The regulator has been used for controlling the supply of blast-furnace gas to stoves, boilers, blowing engines, rolling mills and coke ovens, and also been used to regulate the gas supply to steel furnaces, drying ovens, annealing furnaces and metal mixers, whilst a more recent development is the control of the air supply to producer gas plants.

Power Plant Pyrometers

Since accurate information of temperature is essential to secure efficient control of a power plant, the problem of this measurement has received special study by the Foster Instrument Co., of Letchworth, Herts. As a result, they have developed their well-known "Power Plant Pyrometer." The sensitive end of the thermo-couple is arranged for direct exposure to the steam or gas the temperature of which is to be measured. It follows temperature changes so rapidly that there is practically no "time lag," but it is proof against pressure. A special form of connector secures connection between the stem and the leads to the indicator.

Atmospheric temperature may, and frequently does, vary considerably at different points between the thermo-couple and the indicator. If ordinary copper leads were used to connect the indicator, these variations would have a considerable effect on the reading given, rendering them unreliable. To avoid this, fully compensated leads are used, these being made of materials electrically the same as those in the thermo-couple. They are in concentric form, and the installation is as simple as running an oil pipe. No external insulation is needed, and joints at all points are simple, thus no special tools or knowledge are required in installing.

The indicator employs the patent "Resilia" moving system, combining maximum accuracy and robustness. By the use of compensating leads, the "cold junction" is transferred to the indicator, and in order to obtain the highest accuracy an automatic cold junction device is incorporated. By this means the pointer of the indicator is automatically set to the position on the scale corresponding with the temperature of the cold junction. In those cases where the indicator is unavoidably subjected to vibration, a patented damping device is fitted.

Gas Volume Indicators and Recorders

"Arkon" gas volume indicators and recorders, for the continuous measurement of quantities of gas and air, are supplied by Walker, Crosweller and Co., of 54-58, Queen Elizabeth Street, London, S.E.1. In principle, the instrument depends on the fact that when gas flows through a pipe it banks up before any obstacle like water in a stream. The resistance of the obstacle causes an increase of pressure in front of the obstacle, and a fall of pressure behind it. In this

way a difference of pressure arises which depends on the velocity of the stream, the specific weight of the gas, and the form of the obstacle. The "Arkon" gas volume recorder measures the differential pressures set up by the obstacle, and from this gives at once an indication or a record of the quantity of gas or air passing in a given time. The form of the obstacle which is put into the pipe to set up the necessary pressure difference depends on the particular purpose. A throttle disc or throttle nozzle may be used to embrace the whole of the gas stream, or a Pitot tube, Brabbée tube, or similar device which works only at points in the stream. The recorder may be used in gasworks; in coke oven plants; in blast furnaces and gas producers (measuring the quantity of gas produced, the quantity supplied to different plants or departments, and the air supplied to furnaces and producers); in foundries (for measuring the blasts); in collieries (for measuring the air handled by the fans and its distribution); in chemical works (for many purposes, measuring hot gases, dirty gases, etc.); in the control of fans, blowers and compressors; and for other purposes. This and other recorders and indicators are described in a leaflet issued by Walker, Crossweller & Co.

Low Pressure Gravity System Oil Burner

The oil burner, produced by R. and G. Hislop, of Paisley, works on the gravity system and consequently has the advantage of being much simpler in operation than burners working on the pressure system. In addition there is a great saving of initial cost and in space. The most important factor, however, is that a higher thermal efficiency is obtained and maintained, with a resulting saving of fuel. No costly oil fuel pumps, heaters or strainers are necessary. The oil is led from an overhead storage tank to a small reservoir placed a few feet above the burner and in which the oil is heated to a suitable temperature. The air for the combustion and vaporisation of the fuel is supplied by means of a centrifugal fan at the very low pressure of from 14 in. to 16 in. W.G. Air and fuel regulating valves are provided at the burner and an external adjustment is provided to cope with fuels of varying viscosity.

The design of the burner is very simple, comprising three cylindrical radially concentric passages, with a series of fixed blades accurately fitted inside the vaporiser. This gives a cylindrical incandescent flame which produces a soft radiant heat throughout the furnace, entirely eliminating local heating and its consequent troubles. The burner is silent and smokeless in operation, and the dangers generally associated with oil fuel firing are entirely eliminated in this new system as deflagration takes place at the mouth of the burner and the gases are entirely consumed. Any grade of oil can be burned with equal success.

A New Steam Trap

The Newton automatic steam trap and non-return valve has been put on the market by the Telekron Electric Transmitter Co., of 55, Victoria Street, Westminster, London, S.W.1, who have sent us a description of it. The trap is of simple adjustment and easily fitted. A free outlet for the condense is provided, but no passage for the steam. No special attachment is needed for lifting the condense into the storage tanks. Even with low pressures the lift is sufficient for ordinary needs, and it varies with the pressure of the steam. There is no possibility of the condense returning through the trap to the machines or pipes. The trap consists of five parts only: a tapered body of fine grained iron; a tapered monel metal plug; a gunmetal adjusting screw; a gunmetal lock-nut; and a gunmetal guide cap (not required for all types). When the trap has been fixed, the lock-nut is loosened and the adjusting screw screwed to the limit, closing the trap. The screw is then turned back till a wisp of steam appears, when the screw is held and the lock-nut tightened. The plug is machined to exactly the same taper as the body, and when closed no water or steam can pass. When the trap is adjusted, the pressure of steam and water at the inlet forces the plug from its seating to the limit of its adjustment, allowing the passage of water through the slight aperture formed. When the steam pressure is shut off, the plug, assisted by the weight of water on the discharge side of the trap, returns to its seating, forming a non-return valve.

Automatic Combustion (CO_2) Recorders

For assistance in the correct regulation of the draught to the fuel burned in boiler plants, etc., the "Sarco" Engineering and Trading Co., Ltd. supply an automatic and continuous CO_2 recorder. Such a recorder permits of tests on the exact draught necessary for the most perfect combustion, on suitable methods of firing, on the detection of flaws or cracks in the brickwork, etc. For recording purposes, 1 in. pipes tap the side flues or last combustion chambers of the boilers or furnaces, and a $\frac{3}{4}$ in. main pipe from them is connected to the instrument. For rapid and continuous production of samples, the circuit is completed by another pipe of the same diameter. This is carried to the base of the chimney or to a convenient point in the main flue, well beyond the boiler damper. In average cases, the effect of an alteration in the firing may be read on the chart within two or three minutes of its occurrence. As many as 20 to 30 separate analyses can be recorded per hour. Once erected, the instrument works automatically, and requires little attention beyond changing the chart once every 24 hours, and the renewal of the potash solution every 14 days to three weeks.

Injectors, Valves and Pumps

Products bearing the trade mark "Penberthy" are supplied by W. H. Willcox and Co., Ltd., of 32, 34, 36, and 38, Southwark Street, London, S.E.1. Among other things may be mentioned automatic injectors (ordinary and for special high steam pressure and hot feed water); auto-positive injectors (for high working pressures and for handling hot water supply); "Willcox-Penberthy" valves for hot water and steam radiators, brass regrinding valves, gate valves, and regrinding swing check valves. The company also supplies the "Willcox-Ramoneur" hot-air impelled boiler-tube cleaning apparatus, for multitubular boilers, for removing soot and ashes. The cleaning element in this apparatus is a mixture of hot air and dry steam, the operation is dry throughout, and there is no condensation. Other products are electric boiler scalers; semi-rotary wing, ball-valve, barrel, and portable pumps.

Fire Cement

The makers of "Pyruma" fire cement, J. H. Sankey and Son, Ltd., of Essex Wharf, Canning Town, E.16, state that it may be used for setting, jointing, pointing, and repairing all kinds of firebrick work in furnaces, kilns, retorts, dust destructors, anthracite stoves, ranges, grates, etc. It sets hard without heat, is made in two grades, "Pyruma" (coarse), for temperatures up to 1,760° C. approximately, and "Pyruma" putty (fine), for temperatures up to 1,400° C. "Siluma" fire cement is finer ground and more silicious, and may be used for setting silica bricks. It can be used either as a fire cement or as a wash. "Graphuma" serves the purpose of resisting corrosion and clinkering in firebrick work, either as a cement or a wash. A booklet descriptive of these products may be obtained on application to the makers.

Recording Instruments

"Bristol's" recording, indicating, and controlling instruments are described in a catalogue supplied by J. W. and C. J. Phillips, Ltd., of 23, College Hill, E.C.4. These instruments include recording gauges for pressure and vacuum, recording liquid level gauges, recording thermometers, electric pyrometers, temperature controllers, recording voltmeters and milli-voltmeters, recording ammeters, shunt ammeters, and wattmeters, recording frequency meters, mechanical time recorders, electric time recorders, recording pneumatic and electric tachometers (to record revolutions or speed as of shafting, etc.), recording psychrometers, engine and revolution counters, and other instruments.

Coal Washing Table

To those in charge of power stations there is no need to emphasise the increased thermal efficiency which can be secured by clean washed coal as opposed to raw coal. The "H.-H." Universal Coal Washing Table, supplied by Huntington, Heberlein and Co., of 47-51, King William Street, London, E.C.4, may be used for the washing of small coal, slack, dant, etc., and since such fuels usually command only a relatively low price, the use of such a table enables the colliery owner to produce a clean and saleable fuel from material which, in the past, has been considered only fit for use under the colliery boilers. Moreover, washing has important bearings on the question of ash disposal.

Modern Methods of Industrial Water Softening

Notes on Some Typical Plants

EFFICIENT water softening is, in many branches of industry, a factor essential to economic production. Dyers, bleachers, and finishers especially, and all trades requiring boiler feed water of maximum purity, are sooner or later compelled to consider the necessity of installing water softening plant of some kind.

We give below some account of various types of water softening plant, and it is perhaps worth while to preface a survey of this kind with an outline of the normal causes and effects of hardness in water. In the course of a paper read some time ago before the National Federation of Launderers, Mr. J. P. O'Callaghan (of United Water Softeners, Ltd.), said: "Carbonate of lime, which is chemically identical with marble and chalk, is the substance which usually forms the great part of the hardness of ordinary waters. It is sparingly soluble in pure water, freely soluble in water containing carbonic acid. On removing this gas, either by heat or by adding lime to the water, carbonate of lime is thrown down as a finely divided white precipitate. Carbonate of magnesia is very similar, except that it is somewhat more soluble of itself in pure water than carbonate of lime. Consequently, when treating waters high in carbonate of magnesia, additional lime must be added over and above that required to combine with the carbonate acid, to decompose the carbonate of magnesia and convert it into insoluble magnesium hydrate. Sulphate of lime, or gypsum, is the next widely occurring constituent of water hardness. It uses up soap in the same way as the carbonate of lime and magnesium, but differs from the latter in forming a very hard flint-like scale when evaporated in boilers, which possesses forty-eight times the heat resisting qualities of steel. The consequent waste of coal in boilers covered with sulphate of lime scale can be imagined. Magnesium chloride, beside being a soap-eater like all the others, is a very dangerous salt to have in a boiler feed water, because it decomposes in the presence of steam at the temperature and pressure of the boiler, into free hydrochloric acid and magnesia. The hydrochloric acid attacks the iron of the boiler and serious weakening is the result. The iron salt formed is, in its turn, decomposed by steam and oxygen, and hydrochloric acid is reformed, so that a vicious cycle of corrosion is set up."

The Permutit Method

By employing the "Permutit" zeolite water softening system, United Water Softeners, Ltd., Aldwych House, London, claim that it is now possible to produce for any water supply a completely soft water. The "Permutit" process consists in passing the water through a filter filled with "Permutit," which chemically removes all the hardness and will afterwards give up these impurities when acted on by a solution of salt.

When sodium "Permutit" is brought into contact with hard water, it eliminates the whole of the permanent and temporary hardness, the lime and magnesia contained in the latter being exchanged for the sodium of the "Permutit." This "base-exchange" softening action continues until the sodium in the "Permutit" molecule has been entirely replaced by calcium and magnesium. Regeneration is effected by passing a solution of sodium chloride (common salt) slowly through the filter. No solid residues are formed. The effluent can be sent into the ordinary drains and is entirely innocuous.

The softening power of the plant is drawn upon by the water itself in exact accordance with its hardness and its rate of flow, and "Permutit" prevents all possibility of either under-treatment or over-treatment. Variation in the quality or quantity of the water within the limits of the capacity of the plant makes no difference. The "Permutit" system functions equally well whether operated under pressure or by gravity; and a "Permutit" softener can in consequence be fixed to the water service at any convenient level. This frequently saves double pumping, and allows of an unrestricted choice of position for the softening plant. "Permutit" softeners have no moving parts.

United Water Softeners, Ltd., have recently introduced "Permutit B" for industrial users, and this enables day and night continuous duty to be performed by one unit only, instead of two. The material is capable of complete regeneration in a period of one hour or less and one unit is thus capable of operation both day and night. The advantages of this saving are obvious.

In woollen works the character of the water largely governs the nature of the finished product, and perfect scouring is essential to satisfactory dyeing. Similarly, hard water means uneven dyeing. "Permutit" can also be employed for treating boiler feed water, and it is of interest to note that a large works has installed a plant for treating the entire water supply for boilers and works with a daily capacity of 684,000 gallons.

The Boby "Azed" Plant

This plant is manufactured by William Boby and Co., Ltd., of Brookfield House, 62 and 64, Brook Street, Hanover Square, London. For purposes of illustration, attention may be drawn to a plant of this type erected in a large works.

In this case the water is pumped from a large catchment reservoir in which it is collected from a neighbouring watershed. As it leaves the reservoir, the water is cloudy, containing substances giving rise to hardness, together with a certain amount of free CO_2. The purpose of the plant is first the removal of suspended matter and afterwards the softening of the water, so as to leave no trace of turbidity or hardness. The removal of suspended matter is effected by the action of three mechanical pressure filters that are fitted; these work in parallel discharging the clarified water into two Boby "Azed" softening units, which, in their turn, remove every trace of hardness, giving zero water perfectly clear and soft. The principal feature of interest in the plant is the softening operation, which works on the base exchange principle, its action being to soften water during a whole day's run without interruption. Regeneration by common salt is carried out once only per day, occupying a short time, as the softening bed is rapidly receptive. The material of which the bed consists is "Doucil," a synthetic base exchange softening material manufactured by Joseph Crosfield and Sons, Ltd., and exclusive to the Boby "Azed" plants.

It is claimed that in this plant the features of objection that existed in the older synthetic base exchange methods of German origin are entirely absent. These objections took the form principally of solubility of the bed in CO_2, slow absorption of sodium making regeneration a lengthy operation, and a tendency to give zero water during only a portion of the normal run between regenerations. In the Boby "Azed" plant, the bed is resistant to CO_2, and permanent in character. Regeneration is quickly effected and by special patented methods the quantity of salt employed is very largely reduced. Zero water is delivered throughout the entire period of working. The material has a further advantage of offering so slight a resistance to the passage of the water through it that the loss of head becomes negligible.

All the valves of the filters and of the "Azed" units are grouped in front, the pipes being brought down below ground level and run in trenches. The duplicate brine tanks are located opposite to the softening cylinders, either of which can be worked independently of the other if desired. The brine valves are likewise arranged for easy operation. The filters are specially designed to run for long periods of time between cleansings and are provided with pressure gauges giving sight readings of the loss of head and consequent state of cleanliness of each filter. A master meter records the total quantity of water receiving treatment and the rate at which the plant is working. The capacity of the plant described above is 200,000 gallons per 24 hours.

The Neckar System

While the "Neckar" system of the Neckar Water Softening Co., Sentinel House, Southampton Row, W.C.1, is in extensive use on the continent and all over the world, the system was only introduced into this country about twelve months ago. The company has on the market two different plants: (*a*) a

water softener with a device for the continual removal of sludge; and (*b*) a combined heat-exchanger and evaporator, also with device for the continual removal of salty sludge water.

By the "Neckar" process, the hardness of the crude water is reduced in the softening tank by heat and soda to about 2 to 3° temporary hardness, the whole of the permanent or scale-forming hardness being removed. This residual hardness, on entering the boilers, is precipitated during the evaporation of the water and continuously returned by the sludge return device to the softener, where the heat and alkalinity are utilised in further softening. Pre-heated feed and a slight fixed alkalinity are preventives against corrosion.

The Neckar combined heat-exchanger and evaporator is designed to obviate the necessity for blowing-off as a preventive of density due to concentration of salts present. The company claims that at least 90 per cent. of the heat contained in the boiler water removed is saved and up to 20 per cent. of the water removed is returned as pure distilled water.

By means of the continuous return device above-mentioned, a certain quantity of water is continuously taken to the heat-exchanger. The pressure of the water falls on entering the upper chamber, with a consequent liberation of heat. The heat thus liberated causes some of the water to evaporate and the steam formed is led to the softening tank or feed water tank, i.e., condensed water is saved. The remainder of the water, now of higher density due to the partial evaporation, passes through a feed water heater contained in the lower part of the heat exchanger and evaporator, thereby giving up its heat economically. The cooled salty water is finally discharged.

Paterson Plant

The Paterson Engineering Co., Ltd., Windsor House, Kingsway, London, W.C.2, specialise in almost every branch of water treatment, softening by the lime and soda ash method (with the "Osilameter" byepass feed gear for the reagents), exhaust steam heaters, and oil elimination plant on the coagulent principle. They supply modern rapid gravity filtration plant for towns water supply, with cleaning of the sand beds by compressed air, and have at the present time in hand an installation of 48,000,000 gallons per 24 hours; among others they also specialise on pressure sand filters with compressed air cleaning, and many auxiliaries in connection with water treatment, including the "Fluxograph" V notch recorder, automatic reagent feed gear, coagulent pumps, the "Chloronome" for the continuous addition of a measured trace of chlorine gas to water, over 1,000,000,000 gallons of water per 24 hours being sterilised in this way at the end of 1925.

From the point of view of the average industrial establishment perhaps the most valuable section of water treatment is softening, and the "Osilameter" feed gear is a characteristic part of the Paterson plant, consisting essentially of an upper horizontal chamber in which the water entering the plant flows over a weir. This is divided into two parts by a vertical plate, adjusted as required by a hand wheel, so that about 80 per cent. of the flow of the water passes down direct to the main reaction tank, operating in its passage a vertical water wheel which works an agitator in the lime and soda ash reagent tank. The remaining 20 per cent. passes to a tipping vessel or "Osilameter" provided with two chambers so that as each fills in turn the "Osilameter" is overbalanced and given a reciprocating motion, emptying out the water, which also passes down to the main reaction tank.

To this "Osilameter" reagent buckets are attached, which are always kept filled by cups attached to the agitator working in the reagent tank. As the flow of water varies the "Osilameter" works slower or faster accordingly, always giving the right amount of reagent; but the important point is that if the water alters in hardness all that is necessary to do is to adjust the vertical weir plate, giving more or less operating water to the "Osilameter" and altering the treatment instantly. Combined with the softening plant there may be fitted the "Paterson" heater for use with exhaust steam from engines or other source, a highly efficient arrangement, especially in a chemical works, for boiler feeding, since the heat in the exhaust steam is recovered and the chemical reactions in the softening plant are rendered even more efficient, while all dissolved gases such as air and CO_2 are eliminated. "Paterson" oil eliminators can be installed, either alone or in conjunction with softening plant, so as to separate all traces of oil, which soon causes local overheating and other trouble in the boilers.

Heater-Softeners

Apparatus for the supply of hot soft water for boiler feeding is supplied by Erith's Engineering Co., of Windsor House, Kingsway, London. They deal especially with the "No Lime" process for hard or corrosive waters needing chemical softening in addition to mechanical purification and filtration. One appliance, working automatically, arrests the scale-forming solids, neutralises the corrosive acids, protects from oil, returns to the boilers all the waste heat the feed-water can absorb, filters the water, and records the quantity of water evaporated, as well as all the fluctuations of load. This appliance uses the minimum quantity of a single inexpensive reagent, uses the waste heat for purification as well as for heating, and delivers hot, softened, filtered water to boilers. There are also heater-softeners for condensing plants, using the "No Lime" process, with heat recovery from waste gases.

Applications of Ferro-Concrete

THE use of ferro-concrete in the construction of reservoirs, tanks and water towers (in addition to its use in other structures such as buildings, bridges, culverts, wharves, jetties, bunkers, silos, etc.) is discussed in a brochure issued by K. Holst and Co., of Westminster Chambers, 1, Victoria Street, London, S.W.1. It is pointed out that the material gives results satisfactory from the point of view of watertightness, durability and economy. The design of water-containing structures in ferro-concrete involves a number of special problems, and the proper distribution of the stresses which are set up in the steel and concrete requires very careful consideration. But if due provision is made for these no fear as to the watertightness of the structure need be felt. Moreover, in the case of structures exposed to view, ferro-concrete has the advantage of lending itself to simple architectural treatment.

Manchester "Monthly Record"

THE Manchester Chamber of Commerce is issuing free to members and others a special binder for twelve issues of the *Monthly Record*, the very useful official publication of the Society, and all who use the volume will appreciate this convenient method of keeping the volumes for handy reference. The *Monthly Record* contains statistics, market prices, reports of changes in foreign customs tariffs, details of new Acts of Parliament affecting business, and many other details of permanent value. At the end of each year the Chamber issues an index, and it offers to bind the year's issues for members at cost price.

Strike and Iron Output

OWING to the effect of the general strike and coal stoppage, production of pig iron only amounted to 88,800 tons in May, compared with 539,000 tons in April, and 574,700 tons in May, 1925. Of the 147 furnaces in blast at the end of April only 23 were in operation at the end of May. The production included 29,900 tons of hematite, 10,700 tons of basic, 37,500 tons of foundry, and 4,900 tons of forge pig iron. The production of steel ingots and castings only amounted to 45,700 tons, compared with 661,000 tons in April and 651,000 tons in May, 1925.

Value of Artificial Fertilisers

WE have received a booklet describing a cinema film entitled "Manuring of Grasslands and the Rotation," which is being exhibited to show the effect of various artificial manures on grassland and the rotation of crops. The film is based on official experiments. Many instances are given of the value of phosphates, potash, ammonium sulphate, etc., as fertilisers, not only for grasslands, but also of mangolds, sugar beets, turnips and swedes, potatoes, etc. Demonstrations of the film are being arranged by the Chief Agricultural Adviser to the Potash Syndicate, 39, Victoria Street, Westminster, London, S.W.1, to whom application should be made.

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National Physical Laboratory

Annual Visitation

THERE was a very large attendance at the National Physical Laboratory, at Teddington, on Tuesday, on the occasion of the inspection by the General Board and the Annual Visitation. The visitors were received by Sir Ernest Rutherford, President of the Royal Society and Chairman of the Board, Sir Richard Glazebrook, F.R.S., and the director of the laboratory, Sir J. E. Petavel, F.R.S. Tea was served in the main Aerodynamics Building.

To the chemical visitor the main interest lay in the metallurgical department. Work on the production of pure beryllium is gradually being carried to successful conclusion. The cell used in the electrolysis of the fluoride bath (beryllium, sodium, and barium fluorides) has been enlarged, and fitted with a rotating and lifting cathode. The resultant cathode deposit of beryllium is 99·9 per cent. pure, while after remelting in a pure beryllia pot in the high-frequency induction furnace 99·5 per cent. purity is attained. The use of magnesia pots for the melting has been abandoned, owing to contamination with magnesium formed by reduction. In view of the statement regarding the occurrence of beryl in Canada, which appeared in our last issue, it is of interest that the beryllium compounds required for this work were originally prepared from Canadian beryl, though latterly pure beryllium carbonate has been available as a starting point, this substance being used in the German gas mantle industry.

The preparation of pure silicon is still under investigation, and it may now be obtained in a state of 99·8 per cent. purity.

Light Alloys and Others

Exhibits were shown illustrating the work done on light alloys, particularly of magnesium, of aluminium and silicon, of aluminium, silicon and copper, and of aluminium and copper. Among these exhibits were satisfactory castings from Y alloy, from an aluminium-silicon alloy, from two aluminium copper alloys (4 and 8 per cent. of copper respectively), and from a 93-4-3 per cent. aluminium-copper-silicon alloy. In the foundry a special feature was a demonstration of the use of the high-frequency induction furnace, a 20-80 per cent. chromium-nickel alloy being prepared (melted) and poured. This furnace gives purer products than gas-fired crucible furnaces, and it is used for, among other purposes, the melting of metals required in a state of purity, the preparation of alloys for determination of thermal critical points (alloys of iron) and the preparation of larger melts and the casting of ingots for test and for rolling (nickel-chromium and other alloys required for use at high temperatures). In this department were also shown special refractories, the development and production of which at the laboratory has been of great assistance to the researches carried on.

In an electric pre-heating furnace in the rolling mill of the metallurgical department the new commercial resistor material "Silit" (a substance of German origin, composed of carborundum and nitrites) was shown in use in crucible form. It is being used successfully for high-temperature work (heat treatment and pre-heating), and will resist temperatures up to 1,400° C. Its electrical resistance decreases with temperature, and appears to increase after use.

Various Other Exhibits

The structure of solid mercury was shown under a microscope, the mercury being frozen in a bath of solid carbon dioxide and acetone. This exhibit was connected with work on the preparation and microscopic examination of metals and alloys, liquid or partially liquid, at atmospheric temperatures. An apparatus was shown designed to measure the vapour tensions of metals by a modified manometric method, which gives results at pressures ranging from 10 mm. to 2 atmospheres and at temperatures up to 1,000° C. Such measurements may in the future yield very important results when applied to alloys, etc. There was also an apparatus for the determination of surface tension of molten metals and alloys. Among other exhibits were an X-ray apparatus for the examination of crystal structure (presented by Sir Robert Hadfield), and methods and apparatus (including gradient furnaces, plotting chronographs, etc.) for temperature measurement and the determination of thermal critical points, showing typical heating and cooling curves.

In the chemical division of the metallurgical department there was exhibited apparatus evolved in connection with the researches on the waterproofness and air porosity of porous waterproof fabrics, new methods having been worked out for measuring both these properties. This section also exhibited British standardised samples of iron and steel.

British Standard Specifications

White Spirit, Turpentine and Raw Linseed Oil

THE British Engineering Standards Association has just issued British Standard Specification No. 243-1926 White Spirit, Type 1, for Paints; No. 244-1926, Turpentine Type 1, for Paints; and No. 245-1926, Raw Linseed Oil for Paints. They contain clauses regulating the composition, together with standard reception tests, for the purchase of white spirit, turpentine, and raw linseed oil for paints, and appendices giving methods of carrying out the tests. These specifications have been prepared at the request of the paint manufacturers by a committee representative of both the buying and manufacturing interests, and, as in the case of all British Standard Specifications, they will be reviewed as experience of their working or progress in the industry renders it necessary, and revised issues will be published from time to time. Amongst other specifications in hand which will be published as completed are the following :—

Painting Materials.—Boiled linseed oil, zinc oxide, zinc oxide oil paste, barytes, asbestine, red oxides of iron, lead chrome and Prussian blues.

Ready Mixed Linseed Oil Paints.—White lead, tinted white lead, zinc oxide, tinted zinc oxide, black, green, and red oxide of iron.

Oil Varnishes.—Interior, exterior, rubbing and extra hard drying.

Copies of the new specifications (Nos. 243, 244 and 245-1926) may be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, London, S.W.1, price 1s. 2d. each, post free. The specifications that have already been issued are for genuine dry white lead (No. 239) and genuine white lead oil paste (No. 241).

Oil from Coal

MR. BRYAN LAING and Mr. Harald Nielsen, working jointly, claim to have discovered an important development of low temperature coal distillation. It is said that oils obtained from all varieties of coal are identical, if production is carried out on the proper lines. In this connection it may be mentioned that tests are being carried out at the works of Clarke, Chapman and Co., at Gateshead, of a new fuel of a semi-coke nature produced by the Sensible Heat Distillation Co., of Old Silkstone, near Barnsley. The fuel has been obtained by methods due to Mr. Laing and Mr. Nielsen (presumably as a result of the work referred to above). In the first two hours' test, 70,000 lb. of water were evaporated, giving a steam pressure of 220 lb. per sq. in. by the consumption of 7,550 lb. of fuel. The calorific value of the fuel is 10,670 B.Th.U. per lb., and it is being obtained from small coal purchasable at the pithead for 6s. to 7s. per ton. By the new process of distillation, every ton of coal yields 19½ gal. of crude oil and 7,000 cubic ft. of gas, leaving 15 cwt. of solid fuel of the same structure as ordinary coke. Hence the fuel may be used in the domestic grate. For power producing purposes it is automatically conveyed into a pulveriser, whence the resultant dust is blown to the top of the boiler and sprayed down into the heating chamber.

A Ph.D. at Twenty

MR. JOHN DOBNEY JOHNSON, of Edward Street, Loughborough, has been awarded his Doctorate of Philosophy at London University. He is only twenty years of age, but has already had a brilliant academic career. He entered Loughborough Junior College in 1917 and proceeded to the Senior College in 1921 with a county senior scholarship in pure and applied science.

After three years he obtained a B.Sc. degree of London, with first-class honours, and a royal scholarship in chemistry tenable at the Imperial College of Science and Technology. The award of the Doctorate of Philosophy follows two years of research work.

Further Expansion of the I.G.

New Fields of Operation

In the last issue of The Chemical Age we gave an account of the manner in which the I.G. Farbenindustrie A.-G. had multiplied its activities. In the following notes, translated from an account given in the *Chemiker-Zeitung* for June 16, the information already given is amplified and completed.

By virtue of its production of dyestuffs and of substances used in laundering, bleaching, dyeing and finishing, the I.G. has close contact with the textile factories, which will be strengthened in the future by its increased artificial silk production. Moreover, by the establishment of special shops in the large towns, chiefly for the sale of fabrics dyed or printed with the 50 or 60 I.G. indanthrene colours (a step apparently taken as propaganda for the latter), the I.G. has to a certain extent become a competitor of the other textile undertakings; it is thought that this "indanthrene propaganda" will cause the textile industry as a whole to make special use of these colours.

The problem of the substitution of wool by cotton is believed to have been solved by the I.G. and others by the treatment of cotton with nitric acid, thereby giving it certain of the attributes of wool; by this treatment the cotton acquires increased textile strength and extensibility, and decreased heat conductivity. Waterproofing materials are also manufactured by the I.G. In the list of companies connected with the trust are included five companies under the heading of textiles.

Electrochemical Manufactures and Gases

Apart from very extensive interests, chiefly through its control of the Griesheim-Elektron company, in the electrometallurgical industries (which will be dealt with next week in the Metallurgical Supplement of The Chemical Age), the I.G. is largely concerned in the electrochemical industries. At the Griesheim Bitterfeld factory there are manufactured electrolytic caustic soda and chlorine; graphite (by an electrical method); various artificial abrasives, which are displacing corundum and other natural materials; synthetic rubies, sapphires, and other artificial precious stones (the Deutsche Edelstein Gesellschaft—precious stone company—is under I.G. control). The Griesheim company also manufactures carbon disulphide by electrochemical means. Apart from the above-named electrochemical products the I.G. also manufactures, at three or four factories, calcium carbide, from which the Wackur A.-G. prepares paraldehyde, aldehyde-shellac, copal substitute, acetic acid, alcohol, tetrachloroethane, chloroform, tri- to hexa-chloroethylene, acetone and related products.

As regards production of gases, the I.G. has at least a partial control of this German industry, though the Griesheim-Elektron company, which has large interests in the Lindes Eismaschinen A.-G. and the Deutsche Oxyhydric A.-G. Nitrogen is produced from air by the Linde method at the Leuna and Oppau works on a very large scale. The use of oxygen (also produced in the same process) has largely increased owing to its application in welding methods in the iron industries (*e.g.*, oxy-acetylene welding, etc.). Reference is made in the German Press to American efforts to cheapen production of oxygen; in the United States it is hoped to bring the cost of production of one ton of oxygen down to $3 and, by using oxygen instead of air, to place the production of metals, especially iron, on an entirely new basis.

Synthetic Drugs

The synthetic drug industry in Germany was heavily hit by the war, which greatly encouraged the production of these substances in other countries. As a result, German exports of drugs dropped from 3,800 tons in 1913 to 1,100 tons in 1925. Particular mention may be made of salvarsan and its derivatives, which prior to the war were a German monopoly; these products are now manufactured everywhere. In spite of these facts, it should be noted that very extensive production and research in this field continues. For example, the following figures represent the production of various drugs, in kilograms, for the month of June, 1923: antipyrin, 7,611; aspirin, 15,058; kelmitol, 1,074; neo-salvarsan, 588; neo-silver salvarsan, 19; sodium salvarsan, 160; protargol, 930; urotropin, 480; veronal, 731; pyramidon, 7,834. These figures are chosen from a list comprising more than 100 substances. Among drugs of recent interest is "Bayer 205," which seems to have important applications in the treatment of sleeping sickness. Among the I.G. members are several companies (*e.g.*, Bayer, Höchster Farbwerken, Agfa, etc.) which have long been interested in this branch of the chemical industry.

While German exports of photographic chemicals fell from a value of eight million marks in 1913 to 1¾ million marks in 1924, the export of exposed and unexposed film rose from 15 million marks in 1913 to 21 million in 1924. In the manufacture of films the Agfa company (now absorbed in the I.G.) had in Germany, until a few years ago, a virtual monopoly, and it is to be assumed that it had a considerable share in the above exports. This company is one of the greatest German producers of photographic materials, and is interested in the A.H. Rietzschel company of Munich, which manufactures photographic apparatus.

Miscellaneous Products

In regard to pyrites, Germany has long been dependent on foreign sources. Owing to the large demand for, and production of, sulphuric acid, the Leverkusen branch of the I.G. has long been engaged in the problem of reducing gypsum (with some form of carbon), to convert the sulphur dioxide which could be produced to sulphuric acid, while the residual calcium compound could be utilised as cement. This is regarded as a very important matter, as it would partly obviate the need for imported pyrites. Very large amounts of gypsum are required by the I.G. for the conversion of ammonia to ammonium sulphate, lime being also obtained. On this account the trust has acquired large gypsum deposits.

Among other matters may be mentioned the production of zinc white (lithopone), which is now being carried on at Leverkusen. In conjunction with the Metallbank, of Frankfurt, to whom belongs the Gewerkschaft Sachtleben, the I.G. controls more than half of the German production of mineral and metal colours. The Badische and another branch are occupied in the preparation of synthetic resins and kindred products. Great importance is attached to the production of synthetic tanning materials (in which the Badische company is interested), as this branch may again relieve Germany of the incubus of imports. The Kalle and Co. branch are manufacturing celophane. The I.G. is also producing photographic tracing paper by a new method. Departments concerned with perfumes, ethereal oils, etc., have been instituted at Berlin and Leverkusen, and a perfume company (Delvendahl and Küntzel G.m.b.H.) is included in the list of members of the I.G.

Food Preservatives

Replying to a letter by Mr. J. R. Clynes, in regard to the steps which may be necessary for prevention, by the increased use of refrigeration, of wastage of food which may occur when the new regulations as to preservatives in food come into force, the Food Council says that cold storage accommodation is largely in excess of requirements, and "it would thus appear that the question of the effect of the forthcoming regulations on food supplies does not arise in the case of foodstuffs stored in wholesale cold stores." In regard to the retail trade it is stated that "most of the staple articles of food . . . will not be affected to any appreciable extent . . . since it has not been the custom in recent times to add preservatives to these articles" (*e.g.*, bread, butcher's meat, poultry, fish, vegetables, milk, etc.). The principal articles of food which may be affected by the regulations are butter, bacon and ham, margarine and egg yolk. The Council have been informed that the Departmental Committee on whose report the regulations were based were of opinion that the limited prohibition of preservatives recommended (which has been still further limited by the Ministry of Health) was feasible with the cold storage and refrigeration facilities already existing in this country. The Council's remarks as to the necessity for the greater extension of the use of refrigeration and cold storage were made because they considered that such extension would enable preservatives to be dispensed with to a greater degree than they suggested in their recommendations.

Birmingham University's Oil Department

New Buildings Opened

SIR JOHN CADMAN, chairman of the Advisory Board of Oil Engineering and Refining, formally opened on Saturday, June 19, the new buildings of the Department of Oil Engineering and Refining, Birmingham University. As a souvenir of the event, a gold key was presented to Sir John Cadman by Mr. Barry Peacock, the architect. The opening ceremony, which was followed by luncheon, was witnessed by a large company, including Mr. C. Grant Robertson (Principal of the University), Sir Thomas Holland (President of the Institution of Petroleum Technologists), Sir Frederick Black, Sir William Butler, Bart., Sir Robert Waley Cohen, Sir George H. Kenrick, Sir Edward Manville, Commander Stokes-Rees, R.N., Sir Richard Threlfall, Professor E. C. Williams, Dr. C. H. Lander, Professor J. S. S. Brame, and others.

It is claimed that Birmingham University has placed itself in the position of being the first university in Great Britain to possess a complete plant for training students in drilling simultaneously with laboratory and research work. Other universities, of course, teach oil engineering and refining in laboratory and workshop, but to Birmingham belongs the distinction of being the only one at which the student has the opportunity of combining practical work with theoretical training in oil engineering. The teaching and lecturing staff is headed by Professor A. W. Nash.

Creation of Oil Department

Originally the Oil Department was a part of and subsidiary to the Coal Mining Department, of which for some years Sir John Cadman was at the head. After the war the development of modern transport and interruptions in the supply of coal brought the possibilities of oil increasingly to the front, and the Council of the University decided to establish a special department for the study of oil. This was made possible by the successful efforts of Sir John Cadman in inducing several of the big oil companies to make grants for the erection of the necessary buildings and plant. Five companies subscribed £113,000, which was earmarked for the purpose of developing the oil school and providing the staff and equipment. That money became available in 1921, and out of the accumulated interest it has been possible to erect the new buildings. The principal building consists of two laboratories, one for research purposes and one for the use of students; a lecture theatre, a museum, drawing office, and rooms for the staff. In a bomb-proof detached building, high-pressure experiments on the Bergius process are carried out. Here, also, is an experimental plant for the production of synthetic liquid fuels. Near the new buildings are three drilling rigs (of the American hydraulic rotary, Californian percussion, and Canadian Galician percussion types), and drilling has already been done in one or the other to the depth of a thousand feet or over.

Courses of Study

Speaking at the luncheon, Professor Nash said that they had an advisory board comprising the leading directors and technical officials of the most powerful oil companies, who reviewed their work and advised them on their future work. With that Board he worked in the closest co-operation, both officially and otherwise. Their course of training, from the matriculation stage, extended over a period of three years leading to the ordinary degree, and four years leading to the Honours degree of B.Sc. During the first three years students were given a broad training in the principles, fundamental and general, of petroleum technology and the allied pure and applied sciences. At the end of the third year the students had to choose which branch of the industry they wished to enter, and during their Honours year they specialised. In addition, they had a post-graduate school, open to Honours graduates of approved universities, who had taken either engineering or chemistry as their principal subject. The engineers took a one-year course, and, if successful, obtained a diploma in oil engineering; the chemists took a two years' course, and on successful completion were awarded the M.Sc. degree in Oil Refining. Professor Nash expressed his thanks to the many oil companies, both large and small, for the way in which they had absorbed their students and given them their start in life. All the men who had passed successfully had obtained congenial posts in the industry without difficulty.

Chemical Matters in Parliament

Oil from Coal

The Parliamentary Secretary to the Board of Education (House of Commons, June 22), replying on behalf of the Secretary for Mines, informed Colonel Applin that experiments in the extraction of oil from coal by carbonisation methods were being actively pursued in Great Britain, both at the Fuel Research Station and by a number of firms and individuals. Extensive experiments on the production of oil by the so-called Bergius method of hydrogenating coal were being carried out in Germany. A number of British firms were represented in these experiments, and, by agreement, the Department of Scientific and Industrial Research obtained full information as to results and a voice in determining the course the experiments were to take. Experiments on this and other processes were also being carried out in this country, and it was too early to make any statement as to results.

Dry Rubbing Down of Paints

Lord Henry Cavendish-Bentinck (House of Commons, June 22) asked the Secretary of State for the Home Department how many master painters had caused waterproof sandpaper to be employed in rubbing down; how many are still using it; and whether he had any information as to their views on its practical value as a substitute for dry rubbing down in the painting of houses, interior and exterior?

The Under-Secretary for the Home Department (Captain Hacking) replied that he regretted his inability to supply the precise information asked for in the first part of the question, but the inquiries made indicated that the new process had not been adopted yet to any great extent. As regards the last part he drew attention to the letter which appeared in *The Times* on the 10th instant from the secretary of the Painting Trade Materials Committee of Great Britain and Ireland, in which it was stated that a considerable number of painting trade firms had found the new process both satisfactory as a preventive of lead dust and economical in cost. He understood that this had been the general experience of firms carrying out painting work for the Office of Works which prohibited the use of dry rubbing down in all its painting specifications.

Lord Henry Cavendish-Bentinck then asked if the Home Office had fairly complete information on this question, and asked why it had not been made accessible to members.

Captain Hacking said that he had explained on the Second Reading of the Lead Poisoning Bill that this was largely an experiment, but a great deal of useful work had already been done; as far as the Office of Works was concerned, it had been useful experience, and in all probability the new process would be of great benefit to the working people of the country.

Boiler Setting Cement

A COMPOSITION of natural gums and long asbestos fibre is now being marketed by the Everseal Products, Ltd., of Goldsmith Street, London, who claim that boilers covered with this preparation reduce annually the fuel consumption from 7 per cent. to 15 per cent. The compound sets over the boiler like a solid coat of rubber which expands and contracts with the varying temperatures, adheres firmly, and does not crack or bulge. It seals the entire surface and prevents air leaks and thereby secures the maximum amount of heat from the fuel.

FOAMITE FIREFOAM, LTD., LONDON, announce that they have received a contract from the Anglo-Persian Oil Co., Ltd., for a Foamite installation for the protection of the jetties at Queen's Dock, Swansea.

TAYLOR'S DRUG CO., LTD., Leeds, were successful in claiming £10 17s. from the Keighley Corporation in the Keighley County Court on Tuesday, June 15, for damage to one of their vehicles caused through the negligent driving of one of the Corporation's employees.

THE BRITISH EMPIRE STEEL CORPORATION, LTD., suffered heavy losses in the year ending December last, according to a Montreal report of the president's statement. The combined working capital was reduced during the year from 13,000,000 to 9,500,000 dollars. The profit and loss figures for last year show a deficit of 4,411,000 dollars, compared with a deficit of 2,357,000 dollars in the preceding year. The directors recommend a reorganisation.

From Week to Week

MR. F. LESSER has been appointed to a seat on the board of Borax Consolidated, Ltd.

THE CLAY CROSS COMPANY'S lime burning works at Ambergate, Derbyshire, have been compelled to close down owing to the shortage of coal.

THE DEATH is announced of Mr. E. J. Wilson, chemical engineer, of Blue Boar Court, Manchester, at his residence, West Didsbury.

THE ILLUMINATION RESEARCH COMMITTEE of the Department of Scientific and Industrial Research has just published a pamphlet explaining the lines upon which work is being done.

A FIRE, due to an overheated boiler, broke out on Monday evening in the chemical factory of F. C. Beer and Sons, of Cologne. Three lives were lost and one person was injured, the factory being completely burnt out.

THE INDIGO CROP was estimated for 1924-25 to have an area of 129,200 acres in Madras, Bihar and Orissa, United Provinces, Punjab, Bengal, Bombay and Sind, and the final figure is given as being 99,300 acres.

TAYLOR AND CO., manufacturing chemists, of Glasgow, had a fire on Wednesday, June 16, which broke out in a warehouse, and, owing to the inflammable nature of the stock, caused damage to the extent of about £5,000.

A BIG BLAZE at Wallasey followed an outbreak of fire at the North-Western Oil Refinery's Works, near Penny Bridge. A large quantity of oil and fat was set alight, the building partially gutted, and the machinery damaged. The damage is stated to amount to several thousand pounds.

A NEW CHEMICAL WORKS, it is believed, is contemplated by the Chemical and Metallurgical Co., Ltd., London, at Runcorn. A site, said to be about twenty acres in extent, has been provisionally chosen on land situated a little distance beyond the Wiggs Works of the United Alkali Company.

THE BULGARIAN GOVERNMENT is reported to have approached the Reparations Committee with a view to obtaining its consent to the use of the revenues from the match monopoly and the excise on salt and spirits as guarantees for the refugee loan sanctioned by the Council of the League of Nations.

SIR ALFRED MOND, M.P., replying on behalf of "The Guests" at the annual dinner of the National Federation of Iron and Steel Manufacturers, on Thursday, June 17, emphasised the importance of Empire development; and said in that direction the Government could and should fulfil a useful function.

MR. C. W. SHOPPE, a student of organic chemistry at Leeds University, has been awarded one of the 1851 research exhibitions, valued at about £400 a year. It is expected that the exhibition will be made tenable at Leeds University, where Mr. Shoppe has been in attendance for the past two years.

THE CLAYTON ANILINE CO., Chatham Street, Clayton, were fined 20s. on Wednesday at the Manchester City Police Court for failing to comply with an order to abate the emission of black smoke from their premises. There were several similar summonses, and in the majority of cases the poor quality of the coal supplied and the careless firing of the boilers was pleaded in defence.

SIR ALFRED MOND, M.P., presided at a dinner held in celebration of the twenty-first anniversary of the Society of British Gas Industries on Wednesday. The toast of "The Gas Industry" was proposed by Professor Arthur Smithells, president of the Society in 1911–12, and responded to by Mr. D. Milne Watson, governor of the Gas Light and Coke Co., and president of the National Gas Council.

MR. JAMES HALL, an assistant in Provan Gas Works, has been appointed lecturer on gas manufacture at the Royal Technical College, Glasgow, in succession to Mr. James Macleod, who has resigned. It was stated in the minutes of the Committee on Chemistry and Metallurgy that Mr. Hall had an excellent record in the College chemistry and engineering classes, and had on various occasions given lectures on gas manufacture.

THE STEEL BAND CONVEYOR AND ENGINEERING CO., LTD., of Birmingham, announce that they are acquiring the assets and goodwill of the business carried on up to the present as Steel Belts, Ltd., as and from July 1, 1926. The stock and tools of the latter concern are being transferred to the extensive works at Birmingham. Mr. H. Blackburn, who has hitherto been managing director of Steel Belts, Ltd., will join the firm, and remain in Manchester for the present to attend to business in Lancashire and Yorkshire.

APPLICATIONS ARE INVITED for the following posts: A lecturer in chemistry in the Imperial College of Tropical Agriculture, Trinidad; £450-£25-£500. Preference to applicants with biochemical training and mechanical leaning. Forms of application from the Secretary, 14, Trinity Square, London, E.C.3. July 14.—Demonstrator in the Department of Inorganic and Physical Chemistry, Bedford College for Women. Open to women only. £250-£300. Applications to the Secretary, Regent's Park, London, N.W.1. July 3.

DR. WILLIAM CULLEN, who has been on a tour in South Africa, returned to England on Monday.

FOUR MEN WERE KILLED and over 70 seriously injured when a coke oven blew up at a by-products plant of the Illinois Steel Co. at Gary, Indiana.

BARR AND STROUD, LTD., have contributed jointly with their employees the sum of £106 to the Glasgow infirmaries, etc., for the half-year ended May 31, 1926.

IN AN EXPLOSION of the benzine tanks at the Bruehl Chemical Works, near Cologne, five people were killed and thirty injured. No cause for the explosion has so far been found.

SIR JOHN BRUNNER has promised to defray the entire cost of the equipment of Willaston School for physics and chemistry, according to an announcement made by the headmaster at the speech day proceedings on Saturday, June 19.

DR. E. K. RIDEAL, lecturer in physical chemistry at Cambridge, has written "An Introduction to Surface Chemistry," to which Professor F. G. Donnan has contributed a preface. The book will be published by the Cambridge University Press.

SIR ERNEST RUTHERFORD, Cavendish Professor of Experimental Physics at the University of Cambridge, and Sir Frederick Hopkins, Professor of Biochemistry in the University of Cambridge, have been elected members of the Academy of Sciences at Cracow.

THE NATIONAL FEDERATION OF IRON AND STEEL MANUFACTURERS has elected as president Mr. H. C. Bond (director of Richard Thomas and Co., Ltd.) and as vice-president Mr. J. J. Burton (of Pease and Partners, Ltd., and chairman of the Advisory Committee under the Metalliferous Mines Act).

A FIRE occurred on Sunday in Thomas Parsons and Sons' paint and varnish works, Mitcham, Surrey. The whole of the mixing department in three shops under one roof, filled with expensive material and valuable stock, was destroyed, the damage being officially estimated at about £70,000.

BALDWINS, LTD., are reported to have under consideration the utilisation of their mineral properties at Cribbwr Fawr and Aberdare, near Port Talbot, for by-products. The proposals include the production of gas for supplying the neighbouring townships, and the erection of large works near Kenfig Hill.

THE U.S. HOUSE OF REPRESENTATIVES have passed an Act providing for a fund of $100,000 (£20,000) yearly for five years for the exploration of potash resources in the South-Western States, but chiefly in Texas, which is believed to be a large potential potash field, bearing fair grade deposits at depths ranging from 600 ft. to 2,500 ft.

A CHEMICAL WARFARE COURSE started on Monday, June 14, at the Chemical Warfare School, South Porton, for the staff and senior regimental officers. A second course began on Monday, June 21, for the seniors, and will be followed by another in October. From July to September, regimental instructors will go to South Porton for training in the latest phases of chemical warfare development.

A SUMMONS under the Sale of Food and Drugs Act against George Brampton, fruiterer, of Drury Lane, London, for selling apples containing $\frac{1}{64}$ grain of arsenic per lb. was dismissed by Mr. Fry at Bow Street on Wednesday, June 9, on payment of £5 costs. It was stated that the analyst's certificate did not comply with the Act, and it was agreed that the percentage of arsenic present was not serious.

THE COUNCIL OF ARMSTRONG COLLEGE, Newcastle, have appointed W. E. Curtis, D.Sc., as Professor of Physics and Director of the Physics Department, in succession to Professor Henry Stroud, M.A., D.Sc., who retires at the end of the present session. Dr. Curtis, who is at present Reader in Physics in King's College, London, was for some time a lecturer in Physics at the University of Sheffield, and was educated at the Imperial College of Science and Technology, London.

THE BRITISH PORTLAND CEMENT ASSOCIATION have installed for testing purposes in their laboratory at Westminster a 300-ton compression machine. Recent improvements in manufacture had so increased the strength of cement that the testing machines in existence were found insufficiently powerful to register the breaking point of the hard test cubes now produced. The laboratory is run by the Association—a non-trading organisation—to provide free help and advice on concrete to any firm or individual.

GEORGE ARTHUR BOOTH, of Worsborough Dale, was charged at Barnsley on Thursday, June 17, with attempting to disclose certain trade secrets of his employers, Wood Brothers, glass manufacturers of Barnsley. It was alleged that, on his suspension from work owing to the closing down of a department because of fuel shortage, he wrote to a competitive firm in Rotherham:—"I have in my possession all formulæ now working at Wood Brothers. If you are interested, perhaps you will grant me an interview, as I am willing to part with my knowledge for a consideration." The letter was returned to Wood Brothers by the firm, and Booth, who said he had sent the letter to get work and did not intend to divulge secrets, was bound over for 12 months.

References to Current Literature

British

ACIDS.—Derivatives of tetrahydrocarbazole. Part V. Carboxylic acids. W. M. Collar and S. G. P. Plant. *Chem. Soc. Trans.*, April, 1926, pp. 808–810.

ANALYSIS.—The determination of traces of carbon monoxide. H. Davies and H. Hartley. *J.S.C.I.*, June 4, 1926, pp. 164–168T.

The determination of aluminium oxide in aluminium metal. W. H. Withey and H. E. Millar. *J.S.C.I.*, June 4, 1926, pp. 170–174T.

CAMPHOR.—The synthesis of camphor and menthol. J. Missenden. *Chem. News*, June 11, 1926, pp. 375–377.

FUEL.—Gasoline and substitute motor fuels in Canada, with special reference to synthetic methanol and synthol. Part I. R. E. Gilmore. *Canad. Chem. Met.*, May, 1926, pp. 116–119.

GENERAL.—The periodic system, chemical bonds and crystal structure. A. Sommerfeld. *Nature*, June 5, 1926, pp. 793–795.

The element of atomic number 61; illinium. J. A. Harris, L. F. Yntema and B. S. Hopkins. *Nature*, June 5, 1926, pp. 792–793.

Hæmoglobin. J. Barcroft. *Chem. Soc. Trans.*, May, 1926, pp. 1146–1170.

Electrons, atoms and molecules. T. M. Lowry. *Nature*, May 29, 1926, pp. 33–40 of *Supplement*.

GERMANIUM.—On the separation of germanium. I. Wada and S. Kato. *Chem. News*, June 4, 1926, pp. 358–361.

Germanium. Part II. Germanium tetrachloride and its ammonia compounds. W. Pugh and J. S. Thomas. *Chem. Soc. Trans.*, May, 1926, pp. 1051–1061.

HYDRATES.—The hydrates of chromic nitrate. J. R. Partington and S. K. Tweedy. *Chem. Soc. Trans.*, May, 1926, pp. 1142–1145.

OILS.—The sulphur compounds of Kimmeridge shale oil. F. Challenger, J. Haslam, R. J. Bramhall and J. Walkden. *J. Inst. Petroleum Tech.*, April, 1926, pp. 106–134.

SPECTROSCOPY.—The absorption spectra of some naphthalene derivatives in vapour and solution. H. G. de Laszlo. *Roy. Soc. Proc.*, June, 1926, pp. 355–379.

SULPHATES.—Ethyl hydrogen sulphate. Part II. M. A. Hamid, K. Singh and H. B. Dunnicliff. *Chem. Soc. Trans.*, May, 1926, pp. 1098–1102.

United States

ANALYSIS.—The determination of fluorine. F. G. Hawley. *J. Ind. Eng. Chem.*, June, 1926, pp. 573–576.

The oxygen bomb method for sulphur determinations. M. J. Bradley, R. M. Corbin and T. W. Floyd. *J. Ind. Eng. Chem.*, June, 1926, pp. 583–584.

The bismuthate method for manganese. B. Park. *J. Ind. Eng. Chem.*, June, 1926, pp. 597–598.

BENZYLATION.—The benzylation of amines. Part III. D. H. Peacock. *J. Phys. Chem.*, May, 1926, pp. 673–679.

COLLOIDS.—Organogels of silicic acid—the replacement of water in the hydrogel by alcohol. J. B. Firth and W. L. Purse. *J. Phys. Chem.*, May, 1926, pp. 617–619.

Preparation and colloidal properties of pectin. M. A. Griggs and R. Johnstin. *J. Ind. Eng. Chem.*, June, 1926, pp. 623–625.

DISSOCIATION.—Dissociation of polyvalent substances. Parts I and II. H. S. Simms. *J. Amer. Chem. Soc.*, May, 1926, pp. 1239–1261.

EMULSIONS.—The preparation and conditions of formation of the two possible types of emulsion in the system cresylic acid—gelatine—water. R. M. Woodman. *J. Phys. Chem.*, May, 1926, pp. 658–672.

HALOGEN COMPOUNDS.—Halogen-substituted acridyls. The reactivity of the halogen in them. M. Gomberg and D. L. Tabern. *J. Amer. Chem. Soc.*, May, 1926, pp. 1345–1358.

The preparation of di-iodofumaric acid. L. Eichelberger. *J. Amer. Chem. Soc.*, May, 1926, pp. 1320–1322.

HYDROCARBONS.—A study of the methylation of xylene. The preparation of durene, pentamethylbenzene and hexamethylbenzene. L. I. Smith and F. J. Dobrovolny. *J. Amer. Chem. Soc.*, May, 1926, pp. 1413–1419.

LEATHER.—The properties of shoe leather. J. A. Wilson. *J. Soc. Amer. Leather Chem. Assoc.*, Part III, May, 1926, pp. 241–250; Part IV, June, 1926, pp. 294–299.

Hydrolysis of acid sulphate of chrome leather. J. A. Wilson and G. O. Lines. *J. Soc. Amer. Leather Chem. Assoc.*, June, 1926, pp. 299–302.

PHOSGENE.—The critical constants and vapour tension of phosgene. A. F. O. Germann and Q. W. Taylor. *J. Amer. Chem. Soc.*, May, 1926, pp. 1154–1159.

German

ACETONE.—Progress in the manufacture of acetone by fermentation. S. Bakonyi. *Chem.-Zeit.*, April 10, 1926, pp. 257–258.

ANALYSIS.—The estimation of chlorates and perchlorates. K. Scharrer. *Chem.-Zeit.*, April 17, 1926, p. 274.

The estimation of free acids and fats in technical casein. W. Höpfner and K. Jaudas. *Chem.-Zeit.*, May 5, 1926, pp. 325–326.

CARBON.—Lampblack—properties, preparation, application. Part I. H. Hadert. *Chem.-Zeit.*, May 26, 1926, pp. 379–382.

CEMENTS.—Aluminiferous cements. H. Eisenbeck. *Chem.-Zeit.*, Part II, March 20, 1926, pp. 202–204; Part III, April 3, 1926, pp. 239–240; Part IV, April 7, 1926, pp. 246–248.

COLLOIDS.—Colloidal bismuth hydroxide. C. Paal and L. di Pol. *Ber.*, May 5, 1926, pp. 874–877.

The properties of alkaline silicic acid sols. H. Freundlich and H. Cohn. *Kolloid-Z.*, May, 1926, pp. 28–35.

The constitution of silicic acid sols. Part II. W. Pauli and E. Valko. *Kolloid-Z.*, April, 1926, pp. 289–300.

The mechanism of coagulation. W. W. Lepeschkin. *Kolloid-Z.*, May, 1926, pp. 41–47.

DEHYDROGENATION.—The dehydrogenation of amino acids. M. Bergmann and F. Stern. *Annalen*, May 14, 1926, pp. 20–31.

ISOMERISATION.—The isomerisation of disubstituted acetaldehydes to ketones. S. Daniloff and E. Venus-Danilova. *Ber.*, May 5, 1926, pp. 1032–1043.

The isomerism between dimeric ketenes and cyclobutanediones. G. Schroeter. *Ber.*, May 5, 1926, pp. 973–991.

OXYGEN.—The production of oxygen. G. Illert. *Chem.-Zeit.*, May 26, 1926, pp. 377–379.

QUINONES.—The mechanism of Fichter's synthesis of dialkyldioxy-quinones. F. Kögl and A. Lang. *Ber.*, May 5, 1926, pp. 910–913.

RESINS.—Identification of resins, particularly in linseed oil varnish. K. Brauer. *Chem.-Zeit.*, May 22, 1926, pp. 371–372.

RUBBER.—Colloid-chemical processes during hot vulcanisation. H. Pohle. *Kolloid-Z.*, May, 1926, pp. 1–7.

Miscellaneous

HYDROGENATION.—On the catalytic hydrogenation of the carbonyl group in aromatic compounds under pressure in the presence of copper. Part II. B. Kubota and T. Hayashi. *Bull. Chem. Soc. Japan*, April, 1926, pp. 67–70.

HYDROLYSIS.—The acid hydrolysis of acetoacetic ester. A. Skrabal and A. Zahorka. *Monats. für Chem.*, March 23, 1926, pp. 559–574.

KETONES.—Synthesis of carbocyclic ketones containing 10–18 ring carbon atoms. L. Ruzicka, M. Stoll and H. Schinz. *Helv. Chim. Acta*, March, 1926, pp. 249–264.

Production of cyclo-octanone from azelaic acid. L. Ruzicka and W. Brugge. *Helv. Chim. Acta*, March, 1926, pp. 339–354.

MOLECULAR COMPOUNDS.—Organic molecular compounds. Part XVII. The behaviour of decahydronaphthalene. G. Weissenberger, R. Henke and E. Sperling. *Monats. für Chem.*, March 23, 1926, pp. 483–497.

Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each

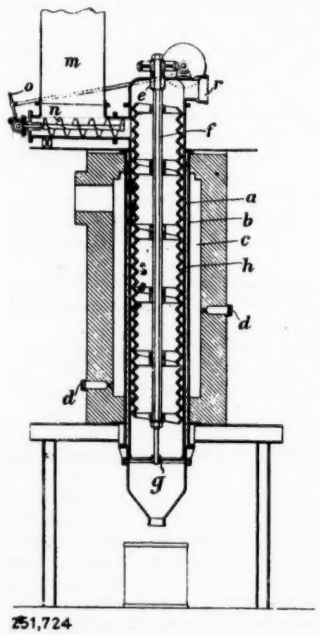
Abstracts of Complete Specifications

251,491. DYES AND DYEING. J. Morton, "Longlands," Lancaster, J. I. M. Jones, 39, Westbourne Road, Lancaster, B. Wylam, Carr House, Regent Street, Lancaster, J. E. G. Harris, Murrell Hill House, Carlisle, and Morton Sundour Fabrics, Ltd., Carlisle. Application date, November 1, 1924.

The object is to obtain dyes which are stable in air, soluble in water and dilute alkali, and suitable for direct dyeing without the employment of the usual vat processes. The dry vat dyestuff and a metal in suitable form are suspended in an organic base and treated with non-alkylated sulphuric acid chloride or its salts, fuming sulphuric acid or sulphuric anhydride or salts of pyro-sulphuric acid. The suspension may be heated, and small quantities of acids or salts may be added. Examples are given in which Caledon Yellow G is treated in suspension in pyridine in the presence of copper with chlor-sulphonic acid, or with zinc and oleum, or with copper and sodium pyrosulphate, or with copper and potassium chlor-sulphonate. Similar processes are given for the treatment of Caledon Blue R, Caledon Jade Green, and Caledon Red BN.

251,678. ALCOHOLS AND ACETONE, MANUFACTURE OF. E. H. Strange, 7, Staple Inn, Holborn, London, W.C. Application date, January 10, 1925.

The object is to produce butyl alcohol and acetone in a stronger mash than usually employed, and thus increase the output of the plant. An approximately sterile mash suitable for the production of ethyl alcohol by the action of yeast, is mixed with yeast and also bacteria which are capable of producing butyl alcohol and acetone. The two fermentations proceed simultaneously. Air should be excluded, and this may be effected in open vessels which are not full, owing to the large evolution of carbon dioxide. The standard of sterility of the mash need not be as high as with the usual process. The mash may be made from starch-containing materials, or from molasses.



251,724

251,724. HEAT TREATMENT OF MATERIALS FOR DISTILLING, DRYING, OR CARBONISING THEM. Thermal, Industrial and Chemical (T.I.C.) Research Co., Ltd., and D. Rider, 52, Grosvenor Gardens, London, S.W.1. Application date, February 27, 1925.

A cylindrical retort *a* of cast iron is surrounded by a jacket *b* containing molten metal, arranged in a furnace *c* heated by gas burners *d*. A vertical shaft *f* is mounted in bearings *e*, *g*, and carries a hollow screw *h*. The material is fed from a hopper *m* by means of a conveyor *n* driven by a pawl lever *o* from the driving gear of the shaft *f*. The hollow screw is perforated, and distillation products are drawn off from its interior through a passage *r*. The vertical retort occupies less ground space than a horizontal retort, and only two bearings are necessary for the shaft *f*. The thin layer of material ensures even heating and the withdrawal of the gases away from the heated walls prevents cracking.

251,755. COAL GAS, PURIFICATION OF. T. V. Miles, G. W. Allott, and Newton Chambers and Co., Ltd., Thorncliffe Ironworks, Sheffield. Application date, April 17, 1925.

The object is to maintain a definite regular temperature in coal gas dry purification plant in which iron oxide is employed, and to avoid the use of steam in the oxide purifiers. The whole or a part of the unpurified gas from the hydraulic main is passed through a heat exchanger to raise the wet purified gas to the necessary temperature before its treatment in the oxide purifiers.

251,890. HALOGENATED ALCOHOLS, MANUFACTURE OF. Farbenfabriken vorm. F. Bayer and Co., Leverkusen, near Cologne, Germany, and H. Meerwein, Königsberg (Ostpreussen), Chemisches Institut der Universität. Application date, June 11, 1925. Addition to 235,584.

Specification 235,584 (See THE CHEMICAL AGE, Vol. XIII, p. 176) describes the manufacture of halogenated alcohols from halogenated aldehydes by dissolving the latter in a primary alcohol and treating with an alcoholate or halogenated alcoholate of aluminium. In the present invention, the latter substances are replaced by a mixture of an alcoholate of aluminium and aluminium chloride.

252,039. FERTILISERS. W. R. Fielding, Manor House, Manor Road, Fleetwood, Lancs. Application date, December 16, 1924.

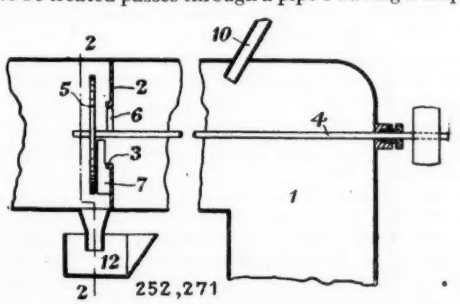
A suitable base of organic matter is treated with a fertiliser such as potassium carbonate or sodium nitrate which are normally deliquescent, in combination with sodium carbonate, sodium sulphate, alums, or other efflorescent material to produce a fertiliser which can be kept in a dry condition.

252,099. SOLUBLE SALTS OF SUBSTITUTED PHENYL ARSINIC ACIDS, PREPARATION OF. R. W. E. Stickings, Ravensbury Park, Mitcham, Surrey, and May and Baker, Ltd., Garden Wharf, Church Road, Battersea, London, S.W.11. Application date, July 1, 1925.

Soluble salts of aminophenyl arsinic acids and their acyl derivatives and the corresponding oxy derivatives of this series are obtained by dissolving the acid in an aqueous or alcoholic solution of piperazine and separating the resulting piperazine salt by crystallisation or precipitation.

252,271. SEPARATING SOLID PARTICLES FROM GASES. Chance and Hunt, Ltd., Oldbury, near Birmingham, and W. A. S. Calder, Ravensthorpe, Harborne, Birmingham. Application date, February 24, 1925.

Gas to be treated passes through a pipe 1 having a diaphragm



2 with an aperture 3. A rotating shaft 4 carries a disc 5 and also a knife 6 which enters the aperture 3 to keep it free from deposits. A scraper 7 is attached to the diaphragm 2. Liquid is sprayed into the gas through a pipe 10 and the moist particles are intercepted by the disc 5 and are collected in a trough 12.

NOTE.—Abstracts of the following specifications which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention:—229,678 (H. Hawlik and O. Sindl), relating to alkali cellulose, see Vol. XII, p. 440; 229,679 (Soc. des Condenseurs Delas), relating to evaporating, concentrating and distilling

apparatus, see Vol. XII, p. 463; 231,459 (Benzonaftene), relating to cracking heavy hydrocarbons, see Vol. XII, p. 564; 235,584 (Farbenfabriken vorm. F. Bayer and Co.), relating to halogenated alcohols, see Vol. XIII, p. 176; 237,875 (Rhenania Verein Chemischer Fabriken Akt.-Ges.), relating to fertilisers, see Vol. XIII, p. 380; 240,834 and 241,184 (Chemische Fabrik Griesheim Elektron), relating to alumina, see Vol. XIII, p. 582, and Vol. XIII, p. 607; 246,147 (Westinghouse Lamp Co.), relating to manufacture of uranium, see Vol. XIV, p. 31 (Metallurgical Section).

International Specifications not yet Accepted

249,884. Dyes. Soc. of Chemical Industry in Basle, Switzerland. International Convention date, March 28, 1925.

An *o*-oxyazo dyestuff produced either by coupling a diazotised polysulphonic acid derived from 2-amino-1-oxynaphthalene-8-sulphonic acid with a coupling component, or by coupling a further sulphonated 1 : 8-oxynaphthalene sulphonic acid with an *o*-oxydiazo compound, is treated with an agent yielding copper or chromium. In an example, the dye from diazotised 2-amino-1-oxynaphthalene-4 : 8-disulphonic acid and 1-phenyl-3-methyl-5-pyrazolone is treated with copper sulphate yielding a product which gives red shades on wool. A large number of examples are given.

249,890–1. Benzanthrone Derivatives. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. (Assignees of Farbwerke vorm. Meister, Lucius, and Brüning, Hoechst-on-Main, Germany.) International Convention date, March 27, 1925.

249,890. A benzanthronyl mercaptan or a benzanthronyl sulphide or disulphide is treated with halogenating agents, *e.g.*, bromine or sulphuryl chloride, to obtain halogenated thiobenzanthrone derivatives.

249,891. The above derivatives are condensed with amines under such conditions that hydrogen halide is split off, and the products yield vat dyestuffs containing nitrogen when treated with alkaline condensing agents. Examples are given.

250,182. Cyanides and Ammonia. Gewerkschaft Sachsen-Weimar, Unterbreizbach-on-Rhone, Germany. International Convention date, April 4, 1925. Addition to 246,177. (See The Chemical Age, Vol. XIV, p. 311.)

Mixtures of coal with alkali or alkaline earth sulphates, or with aluminium or magnesium salts, with or without a catalyst, are treated with nitrogen to obtain cyanides. Crude salts of potash, syngenite, glauberite, kieserite, feldspar, magnesia, magnesium chloride, sulphate or sulphide, or aluminium sulphide may be used. The reaction mass may be treated with steam to obtain ammonia, and may then be regenerated for use again in the production of cyanide by passing over it a gas containing carbon or coal dust.

250,199. Formic Acid. Chemische Fabrik auf Actien (vorm. E. Schering), 170, Mullerstrasse, Berlin. International Convention date, April 6, 1925.

Concentrated formic acid is obtained by treating the aqueous acid with anhydrous copper or magnesium sulphate. The formic acid is filtered off and distilled.

250,208. Barium Silicates. C. Deguide, 11, Rue du Casino, Enghien, Seine-et-Oise, France. International Convention date, April 3, 1925.

Mono-, di-, and tri-barium silicates and other intermediate silicates which have become contaminated with silica or alumina in treating sugar solutions are treated in water with carbon dioxide to obtain barium carbonate. The insoluble material is treated with caustic soda to dissolve the silica and alumina, and the barium carbonate is calcined with silica to obtain barium silicate.

250,211. Complex Fluorides, etc. A. F. Meyerhofer, 10, Goethestrasse, Zurich, Switzerland. International Convention date, April 1, 1925.

Silicofluorides, borofluorides and titanofluorides are treated with hydrogen or steam to obtain the metal or oxides. Iron, copper, chromium, nickel, manganese, tin or zinc may thus be obtained for use as catalysts, or their oxides for use as pigments, fillers, etc. The treating gas may be sulphuretted hydrogen, hydrochloric acid, chlorine, sulphur dioxide, ammonia, etc., to obtain different metal compounds.

250,219. Viscose. P. Moro, 74, Rue St. Savournin. Marseilles. International Convention date, March 31, 1925.

Alkali cellulose is treated with a solution of sulphur in carbon disulphide at 30° to 40° C., and the proportion of carbon disulphide and caustic alkali thereby reduced, while the time of manufacture is less.

250,241. Sulphonic Acids. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. (Assignees of Farbwerke vorm. Meister, Lucius, und Brüning, Hoechst-on-Main, Germany.) International Convention date, April 1, 1925.

An aromatic hydrocarbon and a higher aliphatic or alicyclic alcohol are simultaneously treated in the presence of chlorsulphonic acid instead of sulphuric acid. Nuclear-alkylated or cyclo-alkylated aryl-sulphonic acids are obtained, lower temperatures and less acid being employed. In an example, a mixture of naphthalene and *N*-butyl alcohol at 80° to 100° C. is treated gradually with chlorsulphonic acid, and a solid product may be obtained by neutralising with caustic soda or ammonia, and drying.

250,250. Salts of Organic Acids. I. G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. (Assignees of Farbwerke vorm. Meister, Lucius, und Brüning, Hoechst-on-Main, Germany.) International Convention date, April 6, 1925.

Intermediate compounds for the preparation of dyestuffs and drugs are obtained by heating hydrocarbostyril with barium hydroxide and water under pressure to 150° C. The mixture is then diluted, sodium carbonate added to precipitate the barium, and the filtrate evaporated to obtain the sodium salt of *o*-aminophenyl-propionic acid.

250,251. Dye Preparations. Soc. of Chemical Industry in Basle, Switzerland. International Convention date, April 2, 1925.

Solid preparations of vat dyestuffs are obtained by mixing the dyestuff with alkali carbonate, borate, or phosphate, and with a hydrosulphite after the mixture has been evaporated to dryness. Turkey red oil or sulphite cellulose lye may be added.

250,265. Synthetic Resins. Commercial Solvents Corporation, Terre Haute, Ind., U.S.A. (Assignees of E. R. Littmann, 1920, South 9th Street, Terre Haute, B. K. Brown, 920, South 6th Street, Terre Haute, and W. J. Bannister, 1430, South Center Street, Terre Haute, Ind., U.S.A.) International Convention date, April 1, 1925.

A monoalkyl ester of phthalic acid is prepared by heating phthalic acid with an alkylating agent in molecular proportions and is purified by dissolving in sodium carbonate, extracting any dialkyl phthalate with ether, and precipitating the monoalkyl ester with acid. The ester is dissolved in sodium carbonate or hydroxide, and treated in neutral solution at 70° C., with a salt of a polyvalent metal. The products are synthetic resins or gums, the best results being obtained with normal monobutyl esters.

250,551 and 250,555. Esters of Isoborneol and Borneol. Chemische Fabrik auf Actien (vorm. E. Schering), 170, Müllerstrasse, Berlin. International Convention date, April 11, 1925.

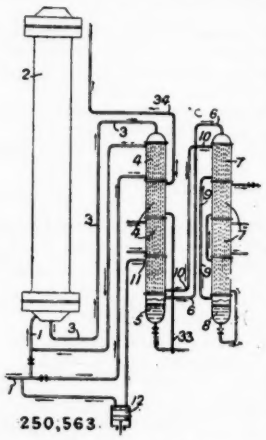
250,551. These esters are obtained by the action of a considerable excess of fatty acid such as formic acid, on camphene at 100° to 150° C., without a catalyst.

250,555. In the above process, catalysts are employed such as pyrophosphoric acid, boric acid, oxalic acid, toluene sulphonic acid, or when mineral acids are used a temperature below 0° C. is maintained.

250,563. Alcohols, Ketones and Ethers. G. Patart, 50, Rue Spontini, Paris. International Convention date, April 9, 1925.

The reaction between oxides of carbon and hydrogen at high temperature and pressure is conducted so as to yield a high proportion of higher alcohols and their ethers and ketones, by using particular catalysts, and by eliminating the carbon dioxide and products in a cyclic process. The catalyst may be a mixture of oxides of silver, copper, zinc, manganese, molybdenum, uranium or vanadium, with a chromate, manganate, molybdate, tungstate, uranate or vanadate of sodium, potassium, rubidium or barium. An example consists of zinc oxide 30 parts, neutral potassium chromate 70 parts, and the mixture must be intimate.

The gas mixture passes by a pipe 1 into the catalyst chamber 2 at 300° to 400° C., and the products pass by a pipe 3 to a condenser 4, in which they are cooled in succession by cold reaction gas, by the alcohols to be evaporated, by cold water, and by cold gases from condenser 7. Alcohols and water are collected at 5, and the uncondensed gases pass on to condenser 7 where they are cooled in succession by residual gases from the bottom of the condenser, by gaseous carbon dioxide from the bottom section, by artificially cooled brine, and by the evaporation of the liquid carbon dioxide product. The carbon dioxide collects at 8, and the gases pass through pipe 9 to the upper condenser section 7 and lower condenser section 4, and thence to pump 12, for return to the chamber 2. The alcohols, etc., from condenser 4 are expanded to liberate dissolved gases, which are returned to the circuit, and then mixed with brine and cooled. The liquid forms two layers, the lower consisting of methyl and ethyl alcohol, and the upper layer is passed through pipe 33 to condenser 4, and thence by pipe 34 for dehydration and rectification. The product consists of propyl, butyl, amyl, hexyl, and heptyl alcohols.



250,563.

250,576. Dyes. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. (Assignees of Akt.-Ges. für Anilin Fabrikation, Treptow, Berlin.) International Convention date, April 9, 1925. Addition to 249,160. (See The Chemical Age, Vol. XIV, p. 527.)

A tetra-alkyl-4 : 4^1-diaminobenzophenone is condensed with di-1-naphthyl-ethylene-diamine in the proportion of one or two molecules of the former to one of the latter. The products give blue-violet shades on wool and cotton mordanted with tannin.

250,577. Synthetic Drugs. Deutsche Gold- und Silber Scheideanstalt vorm. Roessler, 7, Weissfrauenstrasse, Frankfurt-on-Main, Germany. International Convention date, April 11, 1925.

Compounds of the type $R-As=As-R^1$, where R is a substituted or non-substituted heterocyclic radicle and R^1 is a different heterocyclic radicle or an aromatic or aliphatic radicle, are prepared by condensing a heterocyclic arsenoxide or arsine halide with a heterocyclic or aromatic or aliphatic arsine, or a heterocyclic arsine with a heterocyclic or aromatic or aliphatic arsenoxide or arsine halide; or by reducing a mixture of two different heterocyclic arsinic acids or arsenoxides, or a heterocyclic arsinic acid or arsenoxide with an aromatic or aliphatic arsinic acid or arsenoxide; or a mixture of the arsines may be oxidised. A number of examples are given.

250,581. Zinc Sulphide. New Jersey Zinc Co., 160, Front Street, Manhattan, New York. (Assignees of F. G. Breyer, Palmerton, Pa., U.S.A., and C. W. Farber, Bowmanstown, Pa., U.S.A.) International Convention date, April 7, 1925.

To obtain zinc sulphide, zinc oxide made from slab zinc and having a particle size of 0·25 micron is heated with an excess of sulphur which has been re-sublimed, to a temperature of 100°–600° C. The product may be improved in colour by subsequently heating to 600°–800° C. in the presence of steam or other inert gas. Tubular retorts of zinc-coated steel are used.

250,598. Naphthalene Derivatives. Soc. of Chemical Industry in Basle, Switzerland. International Convention date, April 8, 1925.

2 : 3-oxynaphthoic acid is heated in a closed vessel with aqueous ammonia and ammoniacal zinc chloride or ammoniacal calcium chloride to obtain 2 : 3-aminonaphthoic acid. The product is heated, dissolved in hydrochloric acid, and mixed with sodium chloride to obtain the hydrochloride of the amino acid. The free acid is obtained by dissolving in sodium carbonate and acidifying.

Latest Notifications.

253,488. Manufacture of azo-dyestuffs. I. G. Farbenindustrie Akt. Ges. June 9, 1925.

253,507. Process for obtaining light hydrocarbons from heavy hydrocarbons or cyclic derivatives. Kling, A. J., and Florentin, J-M. F. D. June 12, 1925.

253,520. Process for controlling rate of oxidation. Roessler and Hasslacher Chemical Co. June 8, 1925.

253,540. Manufacture of ammonia. Soc. d'Etudes Minières et Industrielles. January 8, 1925.

253,542. Manufacture of synthetic camphor by the use of a liquid catalyst. Darrasse, L., Darrasse, E., and Darrasse, L. June 12, 1925.

253,550. Process for the manufacture of titanium oxide. Blumenfeld, J. June 11, 1925.

253,562. Process for treating hydrocarbon oils. Chemical Research Syndicate, Ltd. June 15, 1925.

Specifications Accepted with Date of Application

231,460. Extracting light hydrocarbons from heavy hydrocarbons. Benzonaftene. March 28, 1924.

232,963. Desulphurising iron. Mathieson Alkali Works. April 23, 1924.

234,104. Nitrogen, or a nitrogen-hydrogen mixture, Manufacture of. Hydrazote. May 19, 1924.

240,163. Earth Metals, Manufacturing by electrolysis. H. Dolter. September 17, 1924.

242,650 and 248,332. Phosphoric acid and generator gas, Manufacture of. W. Kyber. November 7, 1924, and February 25, 1925.

252,262. Titanium pigments, Manufacture of. J. Blumenfeld and M. Mayer. November 28, 1924.

252,455. Metals and alloys, Manufacture of. D. Croese. February 26, 1925.

252,460. Amines and substitution products, and nitriles, Manufacture of. K. F. Schmidt. February 27, 1925.

252,497. Removal of naphthalene, etc., from fuel gases. H. Wade. (*Koppers Co.*) March 25, 1925.

252,500. Metallic xanthates, Manufacture of. British Dyestuffs Corporation, Ltd., C. J. T. Cronshaw, and W. J. S. Naunton. March 27, 1925.

252,570. Isolating alcohols or phenols from mixtures. A. Deppe Söhne, and F. C. Zeitschel. July 21, 1925.

252,573. Catalytic preparation of methanol or higher alcohols or other oxygenated organic compounds. L. Casale. July 27, 1925.

252,594. Hydrogenated dioxy-diphenyl-methane compounds, Manufacture of. Chemische Fabrik auf Actien (vorm. E. Schering). September 9, 1925.

252,609. Hexamethylene-tetramine, Manufacture of. H. Wade. (*S. Karpen and Bros.*) October 23, 1925.

252,617. Yellow azo dyestuffs, Manufacture of. J. Y. Johnson. (*Badische Anilin and Soda Fabrik.*) November 5, 1925.

252,632 and 252,640. Ethylidene diacetate, Preparation of. Soc. Chimique des Usines du Rhône. June 13 and September 18, 1925.

231,841. Vinyl esters or ethers, Manufacture of. Consortium für Elektro-Chemische Industrie Ges. April 1, 1924.

243,361. Colloidal organic mercury compounds soluble in water. W. Carpmael. (*Farbenfabriken vorm. F. Bayer and Co.*) November 18, 1925.

252,756. Treating zinc white, lithopone, and white lead for use in preparation of paint. A. van Lerberghe. January 2, 1925.

252,768. Treating barium peroxide to obtain hydrogen peroxide and an improved "blanc fixe." I. E. Weber, B. Laporte, Ltd., and H E. Alcock. March 2, 1925.

252,786–7. Light oils suitable for fuel for internal combustion engines, producing from water gas, or liquid or solid organic substances. M. Brutzkus. March 5, 1925.

252,820. 2-aminonaphthalene-1-carboxylic acid or its nucleal substitution products, Manufacture of. O. Y. Imray. (*Farbwerke vorm. Meister, Lucius, and Brüning.*) March 12, 1925.

252,848. Alkyl esters of formic acid. J. Y. Johnson. (*Badische Anilin and Soda Fabrik.*) April 22, 1925.

252,870. Normal butyl esters of amino benzoic acids, Manufacture of. E. C. R. Marks. (*Abbott Laboratories*). May 12, 1925.

252,903. Vat colouring matters of the benzanthrone series. J. Y. Johnson. (*Badische Anilin and Soda Fabrik.*) June 11, 1925.

252,922. Anthraquinone derivatives. British Dyestuffs Corporation, Ltd., W. H. Perkin, A. W. Fyfe, and M. Mendoza. July 8, 1925.

252,928. Highly concentrated sulphur dioxide gas. S. G. S. Dicker. (*K. Kudoh.*) July 17, 1925.

252,938. Pure sulphur, Manufacture of. J. Riley and Sons, Ltd., and W. H. Bentley. August 17, 1925.

252,953. Concentrated Phosphoric acid. F. G. Liljenroth. September 22, 1925.

252,957. Diazotisable azo dyestuffs and intermediate products. Chemical Works (formerly Sandoz) and M. Boniger. September 28, 1925.

Applications for Patents

Agthe, C. A. Washing or emulsifying agents. 14,917. June 14. (Germany, June 13, 1925.)

Alexander, S., and Empson Centrifugals, Ltd. Centrifugal purifying and dehydrating apparatus. 14,782. June 11.

Askenasy, P., Crowley, J. F., and Rose, R. Manufacture of barium oxides. 14,646. June 10.

Baddiley, J., British Dyestuffs Corporation, Ltd., Butler, C., and Chorley, P. Process for dyeing. 14,270. June 7.

Baddiley, J., British Dyestuffs Corporation, Ltd., Shepherdson, A., and Thornley, S. Manufacture of benzanthrone derivatives. 15,515. June 19.

Baddiley, J., British Dyestuffs Corporation, Ltd., Shepherdson, A., and Thornley, S. Colouring cement, concrete, etc. 15,517. June 19.

Bentley, W. H., Coates, W. M., Riley and Sons, Ltd., J. Colloidal materials, etc. 14,228. June 7.

Berliner, R., I.G. Farbenindustrie Akt.-Ges., and Schmidt, R. E. Manufacture of anthraquinone derivatives. 14,670, 14,671. June 10.

Blumenfeld, J. Manufacture of titanium oxide. 14,800. June 11. (France, June 11, 1925.)

British Dyestuffs Corporation, Ltd., Hill, J., and Lawrie, L. G. Process for dyeing cellulose esters and ethers. 14,757. June 11.

British Dyestuffs Corporation, Ltd. Production of transparent, etc., vulcanised india-rubber. 15,277. June 17.

British Dyestuffs Corporation, Ltd. Dyestuffs. 15,516. June 19.

Carpmael, W., I.G. Farbenindustrie Akt.-Ges. Manufacture of oxycarboxy-p-diamino-diaryl-sulphones, etc. 14,256. June 7.

Carpmael, W. Manufacture of new arylalkylethers, etc. 14,477. June 8.

Carpmael, W. Reduction of nitro-compounds. 14,672. June 10.

Carpmael, W. Process for converting insoluble colloidal carbohydrate ethers into soluble products. 14,673. June 10.

Carpmael, W., and I. G. Farbenindustrie Akt.-Ges. Manufacture of dry preparations containing formaldehyde. 14,936. June 14.

Carpmael, W., and I. G. Farbenindustrie Akt.-Ges. Manufacture of acidyl cellulose. 14,937. June 14.

Cerini, L. Apparatus for purification of solutions of caustic soda, etc. 15,138. June 16. (Italy, January 29.)

Chemical Research Syndicate, Ltd. Process for treating hydrocarbon oils. 15,074. June 15. (United States, June 15, 1925.)

Classen, A. Production of cellulose from cellulose-containing materials. 14,362. June 7.

Cumberland, E. Prevention of corrosion. 15,037. June 15.

Darco Sales Corporation. Process of treating dye effluents. 15,433. June 18. (United States, December 3, 1925.)

Darco Sales Corporation. Process of reactivating purifying-agents. 15,434. June 18. (United States, April 15.)

Darrasse, E., and Darrasse, L. Manufacture of synthetic camphor. 14,666. June 10. (France, June 12, 1925.)

Dorman, Long and Co., Ltd., and Roelofsen, J. A. Treatment of spent acid, etc. 14,846. June 12.

Empson, A. W. Centrifugal separators. 15,130. June 16.

Gerlach, R. M. Manufacture of pigments, etc. 14,337. June 7.

Hall, A. J. Treatment of cellulose-acetate silk, etc. 14,416. June 8.

Harris, H., and Heverlein, K. B. Manufacture of stannic acid or oxides of tin. 14,805. June 11.

Harris, Hart, and Co., Ltd. Manufacture of ferric sulphate. 14,859. June 12.

Halden, C. Ab-der-. Distillation of tar, etc. 15,432. June 18. (France, June 22, 1925.)

Hall, A. J. Treatment of cellulose-acetate silk, etc. 14,416. June 8.

Harrap, E. R. Manufacture of synthetic resins, etc. 15,424. June 18.

Heyn, M. Production of amido guanidines, etc. 15,427. June 18.

Heyn, M. Production of diguanidines, etc. 15,428. June 18.

Hoffmann-La Roche and Co., Akt.-Ges., F. Manufacture of quinine salts of oxyphenylarsinic acids. 14,551. June 9. (Switzerland, November 6, 1925.)

Holliday and Co., Ltd., L. B., and Shaw, C. Production of direct black vat dyestuffs. 14,982. June 15.

I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of solutions of and solvents for organic compounds. 14,656. June 10.

I.G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Purification of organic compounds. 14,657. June 10.

I. G. Farbenindustrie Akt.-Ges. Manufacture of paraformaldehyde. 15,398. June 18.

I. G. Farbenindustrie Akt.-Ges. Preparation of benzanthrone derivatives. 15,038. June 15. (Germany, June 27, 1925.)

I. G. Farbenindustrie Akt.-Ges. Manufacture of cyclic hydrocarbons. 15,039. June 15. (Germany, June 22, 1925.)

I. G. Farbenindustrie Akt.-Ges. Process for preventing oxidation of magnesium and its alloys. 15,525. June 19. (Germany, June 24, 1925.)

Jelley, E. E. Production of sulphur-dioxide gas. 14,205. June 4.

Jordan, H. and Winter, W. Bleaching, dyeing, etc., apparatus. 13,710. May 31.

Koolman, C. ten Doornkaat-. Production of acid-proof, etc., coatings from artificial resins, etc. 14,481. June 8. (Germany, June 9, 1925.)

Landi, M., and Tocco, L. Rotary chemical furnaces. 14,397. June 8.

Mackert, A. Catalytic methylation of ammonia, etc. 15,242. June 17.

Meiro, A. Extraction of crystals from anthracene, naphthalene, etc. 15,075. June 15. (Belgium, July 15, 1925.)

Meiro, A. Distillation of coal tar. 15,076. June 15. (Belgium, March 2.)

Naess, H. Centrifugal separators. 15,183. June 16. (Norway, June 18, 1925.)

Naugatuck Chemical Co. and Rushen, P. C. Alkylation of aromatic hydrocarbons. 14,268. June 7.

Oliver Continuous Filter Co. Pulp thickeners or filters. 14,775. June 11.

Oppé, A. Manufacture of solid mixtures of alkali hypochlorite and alkali chloride. 15,208. June 17. (Germany, April 17.)

Roessler and Hasslacher Chemical Co. Process for controlling rate of oxidation. 14,272. June 7. (Germany, June 9, 1925.)

Roessler and Hasslacher Chemical Co. Process for promoting oxidation. 14,274. June 7. (United States, January 29.)

Scottish Dyes, Ltd., and Smith, W. Dyestuffs, etc. 14,695. June 10.

Sumpf, P., and Todt, F. W. Conversion of mineral oils, etc., of high boiling point into aliphatic hydrocarbons of low boiling point. 13,973. June 2.

Threlfall, R. Manufacture of activated carbon. 14,181. June 4.

Uhde, G. F. Synthesis of ammonia. 13,997. June 2. (Germany, June 4, 1925.)

Varcoe, R. G. Treatment of china clay. 15,218. June 17.

British Industries Fair of 1927

London and Birmingham Arrangements

THE next British Industries Fair, the thirteenth of the series, will be held at the White City, Shepherd's Bush, London, and at Castle Bromwich, Birmingham, from February 21 to March 4, 1927. This year, especially as regards orders, the Fair was a great success, but there will be an immense amount of leeway to be made up. This Fair, which aims at placing the actual British manufacturer in touch with his clients all over the world, is regarded as one of the cheapest and most efficient means of accomplishing this object. The Fair has been well supported since it began, and many small firms have built up a large business from the opportunities which it has afforded them at a very small outlay. Every year each overseas officer revises his list of trade buyers who should be invited to the Fair. Next year the list of foreign buyers will total not fewer than 50,000, and each one will receive a series of three letters in his own language, informing him of each stage of the Fair's development, and finally the invitation from H.M. Government to attend. It is hoped to distribute 10,000 catalogues in advance of the opening of the Fair to buyers overseas.

Last year H.M. Government allotted a sum of £25,000 for expenditure on publicity for the Fair. This year a similar amount has been made available, and the Department will again have the advantage of the services of Sir C. Higham. Each year the organisers of the Fair profit by experience. Manufacturers of all classes, from the greatest firms and combines in the land down to the small individual employing half a dozen hands, can be assured that if they produce goods, whether of outstanding novelty, outstanding quality, or of outstanding value, they will find the Fair a most efficient means of making them known to traders.

The date of the British Fair has been fixed so that it takes place immediately before the Leipzig Fair opens, and the Leipzig Fair is followed by a continuous round of other continental fairs lasting well into the spring.

Shale Workers' Wage Reductions

THE Executive Council of the National Union of Shale Miners and Oil Workers have decided not to resist the proposed further reduction of 5 per cent. in rates and wages intended by Scottish Oils, Ltd., to take effect from the end of June. A proposal that the men presently unemployed should be balloted on the question was narrowly defeated.

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

Acid Acetic, 40% Tech.—£19 per ton.

Acid Boric, Commercial.—Crystal, £37 per ton, Powder, £39 per ton.

Acid Hydrochloric.—3s. 9d. to 6s. per carboy d/d, according to purity, strength, and locality.

Acid Nitric, 80° Tw.—£21 10s. to £27 per ton, makers' works, according to district and quality.

Acid Sulphuric.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations; 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.

Ammonia Alkali.—£6 15s. per ton f.o.r. Special terms for contracts.

Bisulphite of Lime.—£7 10s. per ton, packages extra, returnable.

Bleaching Powder.—Spot, £9 10s. d/d; Contract, £8 10s. d/d, 4-ton lots.

Borax, Commercial.—Crystal, £23 per ton. Powder, £24 per ton. (Packed in 2-cwt. bags, carriage paid any station in Great Britain.)

Calcium Chlorate (Solid).—£5 12s. 6d. to £5 17s. 6d. per ton d/d, carr. paid.

Copper Sulphate.—£25 to £25 10s. per ton.

Methylated Spirit 64 O.P.—Industrial, 2s. 5d. to 2s. 11d. per gall. Mineralised, 3s. 8d. to 4s. per gall., in each case according to quantity.

Nickel Sulphate.—£38 per ton d/d.

Nickel Ammonia Sulphate.—£38 per ton d/d.

Potash Caustic.—£30 to £33 per ton.

Potassium Bichromate.—4½d. per lb.

Potassium Chlorate.—3¾d. per lb., ex wharf, London, in cwt. kegs.

Salammoniac.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton, carr. paid.

Salt Cake.—£3 15s. to £4 per ton d/d. In bulk.

Soda Caustic, Solid.—Spot lots delivered, £15 2s. 6d. to £18 per ton, according to strength; 20s. less for contracts.

Soda Crystals.—£5 to £5 5s. per ton ex railway depots or ports.

Sodium Acetate 97/98%.—£21 per ton.

Sodium Bicarbonate.—£10 10s. per ton, carr. paid.

Sodium Bichromate.—3½d. per lb.

Sodium Bisulphite Powder 60/62%.—£17 per ton for home market, 1-cwt. iron drums included.

Sodium Chlorate.—3d. per lb.

Sodium Nitrite, 100% Basis.—£27 per ton d/d.

Sodium Phosphate.—£14 per ton, f.o.r. London, casks free.

Sodium Sulphate (Glauber Salts).—£3 12s. 6d. per ton.

Sodium Sulphide Conc. Solid, 60/65.—£13 5s. per ton d/d. Contract, £13. Carr. paid.

Sodium Sulphide Crystals.—Spot, £8 12s. 6d. per ton d/d. Contract, £8 10s. Carr. paid.

Sodium Sulphite, Pea Crystals.—£14 per ton f.o.r. London, 1-cwt. kegs included.

Coal Tar Products

Acid Carbolic Crystals.—4¾d. to 5d. per lb. Crude 60's, 1s. 5d. to 1s. 6d.

Acid Cresylic 97/99.—1s. 8d. to 1s. 9d. per gall. Pale, 95%, 1s. 6d. to 1s. 7d. per gall. Dark, 1s. 3d. to 1s. 4d. per gall. Steady.

Anthracene.—A quality, 3d. to 4d. per unit.

Anthracene Oil, Strained.—7d. to 8d. per gall. Unstrained, 6½d. to 7½d. per gall.

Benzol.—Crude 65's, 1s. 3d. to 1s. 4d. per gall., ex works in tank wagons. Standard Motor, 1s. 10d. to 1s. 11d. per gall., ex works in tank wagons. Pure, 1s. 10½d. to 2s. 6d. per gall., ex works in tank wagons.

Toluol.—90%, 1s. 9½d. to 2s. 1d. per gall. Pure, 2s. to 2s. 6d. per gall.

Xylol.—2s. to 2s. 6d. per gall. Pure, 3s. 3d. per gall.

Creosote.—Cresylic, 20/24%, 9d. to 10d. per gall. Standard specification, middle oil, heavy, 6½d. to 7d. per gall.

Naphtha.—Crude, 9½d. to 1s. 0½d. per gall. according to quality. Solvent 90/160, 1s. 6d. to 2s. per gall. Solvent 90/190, 1s. 1d. to 1s. 4d. per gall.

Naphthalene Crude.—Drained Creosote Salts, £3 10s. to £5 per ton. Whizzed or hot pressed, £5 10s. to £7 10s.

Naphthalene.—Crystals and Flaked, £11 10s. to £13 per ton, according to districts.

Pitch.—Medium soft, 77s. 6d. to 80s. per ton.

Pyridine.—90/140, 17s. to 20s. per gall. Heavy, 7s. to 10s. per gall.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated.

Acid Amidonaphthol Disulpho (1-8-2-4).—10s. 9d. per lb.

Acid Anthranilic.—6s. 6d. per lb. 100%.

Acid Benzoic.—1s. 9d. per lb.

Acid Gamma.—8s. per lb.

Acid H.—3s. 3d. per lb. 100% basis d/d.

Acid Naphthionic.—2s. 2d. per lb. 100% basis d/d.

Acid Neville and Winther.—4s. 9d. per lb. 100% basis d/d.

Acid Sulphanilic.—9d. per lb. 100% basis d/d.

Aniline Oil.—7d. per lb. naked at works.

Aniline Salts.—7d. to 7½d. per lb. naked at works.

Benzaldehyde.—2s. 1d. per lb.

Benzidine Base.—3s. 3d. per lb. 100% basis d/d.

***o*-Cresol 29/31° C.**—3d. to 3½d. per lb.

***m*-Cresol 98/100%.**—2s. 1d. to 2s. 3d. per lb.

***p*-Cresol 32/34° C.**—2s. 1d. to 2s. 3d. per lb.

Dichloraniline.—2s. 3d. per lb.

Dimethylaniline.—1s. 11d. to 2s. per lb. d/d. Drums extra.

Dinitrobenzene.—9d. per lb. naked at works.

Dinitrochlorbenzene.—£84 per ton d/d.

Dinitrotoluene.—48/50° C. 8d. per lb. naked at works. 66/68° C. 9d. per lb. naked at works.

Diphenylaniline.—2s. 10d. per lb. d/d.

***a*-Naphthol.**—2s. per lb. d/d.

***B*-Naphthol.**—11d. to 1s. per lb. d/d.

***a*-Naphthylamine.**—1s. 3d. per lb. d/d.

***B*-Naphthylamine.**—3s. 2d. per lb. d/d.

***o*-Nitraniline.**—5s. 9d. per lb.

***m*-Nitraniline.**—3s. 3d. per lb. d/d.

***p*-Nitraniline.**—1s. 9d. per lb. d/d.

Nitrobenzene.—5d. per lb. naked at works.

Nitronaphthalene.—10d. per lb. d/d.

R. Salt.—2s. 4d. per lb. 100% basis d/d.

Sodium Naphthionate.—1s. 9d. per lb. 100% basis d/d.

***o*-Toluidine.**—8d. per lb. naked at works.

***p*-Toluidine.**—2s. 2d. per lb. naked at works.

***m*-Xylidine Acetate.**—2s. 11d. per lb. 100%.

Wood Distillation Products

Acetate of Lime.—Brown, £8. Grey, £17 10s. per ton. Liquor, 9d. per gall. 32° Tw.

Charcoal.—£7 to £9 per ton, according to grade and locality.

Iron Liquor.—1s. 6d. per gall. 32° Tw. 1s. 2d. per gall., 24° Tw.

Red Liquor.—9½d. to 1s. per gall.

Wood Creosote.—2s. 9d. per gall. Unrefined.

Wood Naphtha, Miscible.—3s. 6d. per gall. 60% O.P. Solvent, 3s. 6d. per gall. 40% O.P.

Wood Tar.—£3 to £5 per ton, according to grade.

Brown Sugar of Lead.—£39 to £40 per ton.

Rubber Chemicals

Antimony Sulphide.—Golden, 6d. to 1s. 5d. per lb., according to quality, Crimson, 1s. 3d. to 1s. 7½d. per lb., according to quality.

Arsenic Sulphide, Yellow.—2s. per lb.

Barytes.—£3 10s. to £6 15s. per ton, according to quality.

Cadmium Sulphide.—2s. 9d. per lb.

Carbon Bisulphide.—£20 to £25 per ton, according to quantity.

Carbon Black.—5½d. per lb., ex wharf.

Carbon Tetrachloride.—£46 to £55 per ton, according to quantity, drums extra.

Chromium Oxide, Green.—1s. 2d. per lb.

Diphenylguanidine.—3s. 9d. per lb.

Indiarubber Substitutes, White and Dark.—5½d. to 6½d. per lb.

Lamp Black.—£35 per ton, barrels free.

Lead Hyposulphite.—9d. per lb.

Lithopone, 30%.—£22 10s. per ton.

Mineral Rubber "Rubpron."—£13 12s. 6d. per ton f.o.r. London.

Sulphur.—£9 to £11 per ton, according to quality.

Sulphur Chloride.—4d. per lb., carboys extra.

Sulphur Precip. B.P.—£47 10s. to £50 per ton.

Thiocarbamide.—2s. 6d. to 2s. 9d. per lb. carriage paid.

Thiocarbanilide.—2s. 1d. to 2s. 3d. per lb.

Vermilion, Pale or Deep.—5s. 3d. per lb.

Zinc Sulphide.—1s. 1d. per lb.

Pharmaceutical and Photographic Chemicals

Acid, Acetic, 80% B.P.—£39 per ton ex wharf London in glass containers.

Acid, Acetyl Salicylic.—2s. 4d. to 2s. 5d. per lb. Brisk demand.

Acid, Benzoic B.P.—2s. to 2s. 3d. per lb., according to quantity.

Acid, Boric B.P.—Crystal, £43 per ton; Powder, £47 per ton. Carriage paid any station in Great Britain, in ton lots.

Acid, Camphoric.—19s. to 21s. per lb.

Acid, Citric.—1s. 4d. to 1s. 4½d. per lb., less 5%.

Acid, Gallic.—2s. 8d. per lb. for pure crystal, in cwt. lots.

Acid, Pyrogallic, Crystals.—6s. 7d. per lb. Resublimed, 7s. 3d.

Acid, Salicylic.—1s. 3½d. to 1s. 4½d. per lb. Technical.—10¾d. per lb.

Acid, Tannic B.P.—2s. 10d. per lb.

Acid, Tartaric.—1s. 0½d. per lb., less 5%. Market firm.

Amidol.—8s. 6d. per lb., d/d.

Acetanilide.—1s. 7d. to 1s. 8d. per lb. for quantities.

Amidopyrin.—12s. 6d. per lb.

Ammonium Benzoate.—3s. 3d. to 3s. 6d. per lb., according to quantity.

Ammonium Carbonate B.P.—£37 per ton. Powder, £39 per ton in 5 cwt. casks.

Atropine Sulphate.—11s. per oz. for English make.

Barbitone.—9s. per lb.

Benzonaphthol.—3s. 3d. per lb. spot.

Bismuth Carbonate.—12s. 6d. to 14s. 3d. per lb.

Bismuth Citrate.—9s. 6d. to 11s. 3d. per lb.

Bismuth Salicylate.—10s. 3d. to 12s. per lb.

Bismuth Subnitrate.—10s. 9d. to 12s. 6d. per lb. according to quantity.

Borax B.P.—Crystal, £27; Powder, £28 per ton. Carriage paid any station in Great Britain, in ton lots.

Bromides.—Potassium, 1s. 9d. to 1s. 11d. per lb.; sodium, 1s. 11d. to 2s. 2d. per lb.; ammonium, 2s. 2d. to 2s. 5d. per lb., all spot.

Calcium Lactate.—1s. 3d. to 1s. 4d.

Chloral Hydrate.—3s. 3d. to 3s. 6d. per lb., duty paid.

Chloroform.—2s. 3d. to 2s. 7½d. per lb., according to quantity.

Creosote Carbonate.—6s. per lb.

Formaldehyde.—£40 per ton, in barrels ex wharf.

Guaiacol Carbonate.—7s. 6d. per lb.

Hexamine.—2s. 4d. to 2s. 6d. per lb.

Homatropine Hydrobromide.—30s. per oz.

Hydrastine Hydrochloride.—English make offered at 120s. per oz.

Hydrogen Peroxide (12 vols.).—1s. 8d. per gallon f.o.r. makers' works, naked.

Hydroquinone.—4s. 3d. per lb., in cwt. lots.

Hypophosphites.—Calcium, 3s. 6d. per lb., for 28-lb. lots; potassium, 4s. 1d. per lb.; sodium, 4s. per lb.

Iron Ammonium Citrate B.P.—2s. to 2s. 3d. per lb. Green, 2s. 4d. to 2s. 9d. per lb. U.S.P., 2s. 1d. to 2s. 4d. per lb.

Iron Perchloride.—20s. to 22s., according to quantity.

Magnesium Carbonate.—Light Commercial, £31 per ton net.

Magnesium Oxide.—Light Commercial, £67 10s. per ton, less 2½%, price reduced; Heavy Commercial, £22 per ton, less 2½%; Heavy Pure, 2s. to 2s. 3d. per lb., according to quantity.

Menthol.—A.B.R. recrystallised B.P., 18s. 9d. net per lb., Synthetic, 12s. 6d. to 15s. per lb., according to quality.

Mercurials.—Red oxide, 5s. 11d. to 6s. 1d. per lb.; Corrosive sublimate, 4s. 3d. to 4s. 5d. per lb.; white precipitate, 4s. 9d. to 4s. 11d. per lb.; Calomel, 4s. 6d. to 4s. 8d. per lb.

Methyl Salicylate.—1s. 5d. to 1s. 7d. per lb.

Methyl Sulphonal.—16s. 6d. per lb.

Metol.—9s. per lb. British make.

Paraformaldehyde.—1s. 9d. for 100% powder.

Paraldehyde.—1s. 4d. per lb. (1s. 2d. in carboys.)

Phenacetin.—4s. per lb.

Phenazone.—6s. per lb.

Phenolphthalein.—4s. per lb.

Potassium Bitartrate 99/100% (Cream of Tartar).—80s. per cwt., less 2½% for ton lots.

Potassium Citrate.—2s. to 2s. 1d. per lb.

Potassium Ferricyanide.—1s. 9d. per lb. in cwt. lots. Quiet.

Potassium Iodide.—16s. 8d. to 17s. 5d. per lb., according to quantity.

Potassium Metabisulphite.—6d. per lb., 1-cwt. kegs included, f.o.r. London.

Potassium Permanganate.—B.P. crystals, 6½d. per lb., spot.

Quinine Sulphate.—1s. 8d. to 1s. 9d. per oz., in 100 oz. tins.

Resorcin.—4s. to 5s. per lb., spot.

Saccharin.—55s. per lb.

Salol.—3s. per lb.

Sodium Benzoate, B.P.—1s. 10d. to 2s. 2d. per lb.

Sodium Citrate, B.P.C., 1911.—1s. 9d. to 1s. 11d. per lb., B.P.C., 1923. 2s. to 2s. 2d. per lb., according to quantity.

Sodium Ferrocyanide.—4d. per lb. carriage paid.

Sodium Hyposulphite, Photographic.—£15 5s. per ton, d/d consignee's station in 1-cwt. kegs.

Sodium Nitroprusside.—16s. per lb.

Sodium Potassium Tartrate (Rochelle Salt).—75s. to 80s. per cwt., according to quantity.

Sodium Salicylate.—Powder, 1s. 9d. to 1s. 10d. per lb. Crystal, 1s. 10d. to 1s. 11d. per lb.

Sodium Sulphide, pure recrystallised.—10d. to 1s. 2d. per lb.

Sodium Sulphite, anhydrous, £27 10s. to £28 10s. per ton, according to quantity; 1-cwt. kegs included.

Sulphonal.—11s. per lb.

Tartar Emetic, B.P.—Crystal or Powder, 1s. 10d. to 1s. 11d. per lb.

Thymol.—12s. to 13s. 9d. per lb.

Perfumery Chemicals

Acetophenone.—10s. per lb.

Aubepine (ex Anethol).—10s. per lb.

Amyl Acetate.—3s. per lb.

Amyl Butyrate.—5s. 6d. per lb.

Amyl Salicylate.—3s. 3d. per lb.

Anethol (M.P. 21/22° C.).—6s. per lb.

Benzyl Acetate from Chlorine-free Benzyl Alcohol.—2s. 3d. per lb.

Benzyl Alcohol free from Chlorine.—2s. 3d. per lb.

Benzaldehyde free from Chlorine.—2s. 6d. per lb.

Benzyl Benzoate.—2s. 9d. per lb.

Cinnamic Aldehyde Natural.—20s. per lb.

Coumarin.—11s. 9d. per lb.

Citronellol.—15s. per lb.

Citral.—9s. 6d. per lb.

Ethyl Cinnamate.—10s. per lb.

Ethyl Phthalate.—3s. per lb.

Eugenol.—10s. per lb.

Geraniol (Palmarosa).—20s. per lb.

Geraniol.—6s. 3d. to 11s. 6d. per lb.

Heliotropine.—5s. 9d. per lb.

Iso Eugenol.—14s. per lb.

Linalol.—14s. to 17s. 6d. per lb.

Linalyl Acetate.—17s. to 20s. per lb.

Methyl Anthranilate.—9s. 3d. per lb.

Methyl Benzoate.—5s. per lb.

Musk Ketone.—34s. 6d. per lb.

Musk Xylol.—8s. per lb.

Nerolin.—4s. per lb.

Phenyl Ethyl Acetate.—12s. per lb.

Phenyl Ethyl Alcohol.—9s. 6d. per lb.

Rhodinol.—27s. 6d. per lb.

Safrol.—1s. 8d. per lb.

Terpineol.—1s. 6d. per lb.

Vanillin.—21s. 6d. to 23s. per lb.

Essential Oils

Almond Oil.—11s. 6d. per lb.

Anise Oil.—3s. 1d. per lb.

Bergamot Oil.—28s. 6d. per lb.

Bourbon Geranium Oil.—11s. per lb.

Camphor Oil.—60s. per cwt

Cananga Oil, Java.—20s. per lb.

Cinnamon Oil, Leaf.—6d. per oz.

Cassia Oil, 80/85%.—9s. 3d. per lb.

Citronella Oil.—Java, 85/90%, 2s. 8d. Ceylon, 2s. per lb.

Clove Oil.—6s. 3d. per lb.

Eucalyptus Oil, 70/75%.—1s. 10d. per lb.

Lavender Oil.—French 38/40%, Esters, 20s. per lb.

Lemon Oil.—7s. 9d. per lb.

Lemongrass Oil.—4s. 6d. per lb.

Orange Oil, Sweet.—11s. 9d. per lb.

Otto of Rose Oil.—Bulgarian, 65s. per oz. Anatolian, 30s. per oz.

Palma Rosa Oil.—12s. per lb.

Peppermint Oil.—Wayne County, 75s. per lb. Japanese, 9s. 6d. per lb.

Petitgrain Oil.—9s. per lb.

Sandal Wood Oil.—Mysore, 26s. per lb. Australian, 17s. 3d. per lb.

London Chemical Market

The following notes on the London Chemical Market are specially supplied to* THE CHEMICAL AGE *by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.

London, June 24, 1926.

TRADE still continues on the quiet side, and there is very little of interest to report. Prices on the whole continue steady, and the one or two changes that are to be noted are in the nature of advances.

Export trade has also been somewhat flat.

General Chemicals

ACETONE is firm, and business has been done on the basis of £82 to £83 per ton; stocks continue very light.

ACID ACETIC.—There is still only a very moderate demand, and the price is still unchanged at £37 to £39 per ton for 80% technical, with £1 per ton extra for pure.

ACID FORMIC.—The demand on home trade account continues somewhat small, and the price is unchanged; inquiries for export, however, have been much better.

ACID LACTIC is unchanged in value, and the price is quoted at £43 per ton for 50% by weight.

ACID OXALIC.—There is still a certain amount of competition from second hand, but the main holders are very firm in their idea of price at 3¾d. per lb.

ACID TARTARIC.—The market is unchanged at 11½d. per lb., and the demand is fairly good.

ALUMINA SULPHATE.—Competition is very keen, and the price is lower at £5 12s. 6d. to £5 15s. per ton for 17-18%, while slightly lower prices are accepted for contracts.

AMMONIUM CHLORIDE continues a quiet market, and business is reported at £18 to £18 10s. per ton.

ARSENIC still continues quiet, and is without change in value, at £13 10s. to £14 per ton.

BARIUM CHLORIDE is slightly better, and is now quoted at £10 per ton.

EPSOM SALTS are fairly active at £5 12s. 6d. per ton.

FORMALDEHYDE.—The market is steady at £41 per ton, with a fair demand, and a further increase is not unlikely.

IRON SULPHATE is in short supply but extremely firm in price.

LEAD ACETATE has been advanced in value, and is now quoted at £46 to £47 per ton for white, and brown at £44 to £45 per ton.

METHYL ALCOHOL is unchanged.

METHYL ACETONE is weak and in poor demand, at £55 to £56 per ton.

POTASSIUM CARBONATE and CAUSTIC unchanged.

POTASSIUM CHLORATE remains fairly firm, and a fair business has been done at 3½d. per lb., export demand has been good.

POTASSIUM PERMANGANATE is called for only in small quantities, and is quoted at 7½d. per lb.

POTASSIUM PRUSSIATE continues its firmer tendency, and is quoted at from 7d. to 7¼d. per lb.

SODIUM ACETATE is as firm as ever at £20 to £21 per ton; export demand is extremely active.

SODIUM BICHROMATE.—British makers' prices are unchanged, but foreign supplies can be obtained at under the ruling rates.

SODIUM NITRITE is unchanged in value at £20 10s. per ton, but only a small demand is reported.

SODIUM PHOSPHATE is a firm spot, the material being quoted at £13 10s. per ton, with a fairly moderate demand.

SODIUM PRUSSIATE.—A fair business is reported at the current price of 3¾d. to 4d. per lb.

SODIUM SULPHIDE is unchanged, with little business passing.

ZINC SULPHATE is in moderately active request at £14 per ton.

Coal Tar Products

Owing to the continuance of the coal strike, prices quoted are in all cases more or less nominal.

90's BENZOL.—There are no quotations, except for continental material. The price asked is 2s. 2d. per gallon, f.o.b. continental port, naked.

PURE BENZOL is unobtainable.

CREOSOTE OIL is considerably firmer; the price is from 6¾d. to 7d. per gallon on rails in the provinces. The price in London for spot parcels is steady at 7½d. per gallon at makers' works.

CRESYLIC ACID is in very great demand, especially the pale quality 97-99%, and the improved 99-100% quality, the price for these being 2s. 3d. per gallon on rails, while the dark quality is quoted at 1s. 11d. to 2s. per gallon on rails.

SOLVENT NAPHTHA.—There are practically no stocks; 1s. 10d. per gallon is being paid on rails at makers' works.

HEAVY NAPHTHA shows improvement, and is worth 1s. 4d. to 1s. 5d. per gallon on rails for the few parcels offered.

NAPHTHALENES are slightly better in the higher grades; 76-78 quality is worth about £6 10s., and 74-76 quality £5 10s. at makers' works. There is no demand for the lower grades.

Latest Oil Prices

LONDON. — LINSEED OIL closed steadier. Spot, ex mill, £34 5s.; June, £33 2s. 6d.; July-August, £33 5s.; September-December, £33 7s. 6d.; January-April, £34. RAPE OIL nominal. Crude, extracted, spot, £49; technical, refined, £51. COTTON OIL quiet. Refined common edible, £45; Egyptian crude, £40; deodorised, £47. TURPENTINE quiet and 3d. lower. American, spot, 70s. 6d.; June, 70s.; and July-December, 61s. per cwt.

HULL. — LINSEED OIL steady. Spot, £33 7s. 6d.; July-August, £33 10s.; September-December, £33 10s.; and January-April, £34. COTTON OIL.—Bombay crude, £37 10s.; Egyptian crude, £40; edible refined, £44 10s.; and technical, £41 5s. PALM KERNEL OIL, crushed naked, 5½ per cent., £44. GROUNDNUT OIL.—Crushed extracted, £47 10s.; deodorised, £51 10s. SOYA OIL.—Crude extracted, £38; and crushed, £38; deodorised, £41 10s. RAPE OIL.—Crushed extracted, £48 10s.; and refined, £50 10s. CASTOR OIL.—Pharmaceutical, in barrels, 50s. 6d. to 51s. 6d.; firsts, 45s. 6d. to 46s. 6d.; seconds, 43s. 6d. to 45s. 6d. per cwt. COD OIL.—Spot, 30s. per cwt. in barrels.

Nitrogen Products

Export.—During the last week the market for sulphate of ammonia has been quiet. Prices have remained unchanged. British producers are able to sell for export in small quantities which are manufactured near the ports, but business is merely of a hand-to-mouth nature and no large sales even for forward delivery can be made. It is understood that the large continental producers have made large sales for delivery between now and the end of the year. Java and Japan have already purchased fair quantities for forward delivery, but these purchases are nothing near their total requirements for the year. The Mediterranean countries continue to buy as required.

Home.—Home prices for the new fertiliser season have not yet been announced. On account of the small quantities available and the liability to a still further prolongation of the coal stoppage, the producers continue to wait and see before committing themselves to a commencing price. As the demand is almost negligible in June and July, this is not inconveniencing the merchant or the consumer. Any small quantities now required are being sold on the basis of £13 1s. per ton for neutral quality, 21·1% nitrogen, delivered to consumer's nearest station.

Nitrate of Soda.—The nitrate market continues quiet. The trade generally hope that something will come of the discussions between the Nitrate Association and the Chilean Government regarding the reduction of the export tax on nitrate. In any case the large stocks in Chile and in consuming countries tend to retard any vigorous buying. The new price scale commenced at 18s. 3d. per metric quintal, but it is doubtful if the producers will be able to carry this scale through the year without increasing the already somewhat inflated stock.

Calcium Cyanamide

THE demand for this material has slackened as the fertiliser season draws to a close. Some demand, however, is still being experienced for use on late root crops and for charlock destruction. Calcium cyanamide contains 19 per cent. nitrogen and about 60 per cent. lime. The price to British farmers for June delivery is £10 6s. per ton for 4 ton lots, carriage paid to any railway station.

Mercury Prices

MAY AND BAKER, LTD., announce that owing to the high price of quicksilver, which has every indication of being maintained, it has become necessary to readjust the prices of salts, which we now quote as follows :—

	Under 112 lb.	Not less than 112 lb.
Ammoniated Lump B.P. (White Precip.) ...	4/11	4/10 lb.
,, Powder	5/–	4/11 ,,
,, Extra Fine Powder	5/1	5/– ,,
Bichloride Lump B.P. (Corros. Sub.).....	4/5	4/4 ,,
,, Pdr. B.P. or granular	3/11	3/10 ,,
Chloride B.P. (Calomel)	4/8	4/7 ,,
Red Oxide Cryst. B.P. (Red Precip.)	6/1	6/– ,,
,, ,, Levig B.P.	5/7	5/6 ,,
Yellow Oxide B.P.	5/5	5/4 ,,
Persulphate White B.P.C.	4/8	4/7 ,,
Sulphide Black (Hyd. Sulph. cum Sulph. 50%)	4/5	4/4 ,,

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE *by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.*

GLASGOW, *June* 23, 1926.

DURING the past week conditions in the heavy chemical market have shown little difference from those prevailing for the past two or three weeks, things being quiet owing to the continued trouble in the coal industry. Prices on the whole remain fairly steady.

Industrial Chemicals

ACID ACETIC.—98/100%, £55 to £67 per ton according to quantity and packing, c.i.f. U.K. port; 80% pure, £39 to £41 per ton; 80% technical, £38 to £39 per ton.

ACID BORIC.—Crystal, granulated or small flakes, £37 per ton; powdered, £39 per ton, packed in bags, carriage paid U.K. stations.

ACID CARBOLIC, ICE CRYSTALS.—Price remains unchanged at about 4¾d. per lb., delivered or f.o.b. U.K. ports.

ACID CITRIC, B.P. CRYSTALS.—Remains in good demand and price unchanged at about 1s. 3¼d. per lb., less 5% ex store. Quoted a fraction less to come forward.

ACID FORMIC, 85%.—Unchanged at about £50 per ton, ex wharf, prompt delivery. On offer from the continent at £49 per ton, c.i.f. U.K. ports.

ACID HYDROCHLORIC.—In little demand. Price 6s. 6d. per carboy, ex works.

ACID NITRIC, 80%.—Usual steady demand and price unchanged at £23 5s. per ton, ex station, full truck loads.

ACID OXALIC, 98/100%.—In rather poor demand, quoted 3¼d. per lb., ex store. Offered from the continent at about 3⅜d. per lb., ex wharf.

ACID SULPHURIC.—144°, £3 12s. 6d. per ton; 168°, £7 per ton, ex works, full truck loads. Dearsenicated quality, 20s. per ton more.

ACID TARTARIC, B.P. CRYSTALS.—In steady demand, quoted 11¼d. per lb., less 5% ex wharf.

ALUMINA SULPHATE, 17/18%, IRON FREE.—On offer from the continent at about £5 8s. 6d. per ton, c.i.f. U.K. ports. Spot material quoted £6 5s. per ton, ex store.

ALUM, LUMP POTASH.—Spot material on offer at £9 5s. per ton, ex store. Quoted £7 17s. 6d. per ton, c.i.f. U.K. ports. Crystal powder on offer at about £7 12s. 6d. per ton, c.i.f. U.K. ports. Spot material, £8 10s. per ton, ex store.

AMMONIA ANHYDROUS.—Imported material selling at about 11¼d. to 11½d. per lb., ex wharf, containers extra and returnable.

AMMONIA CARBONATE.—Lump, £37 per ton; powdered, £39 per ton, packed in 5 cwt. casks, delivered or f.o.b. U.K. ports.

AMMONIA, LIQUID, 880°.—Unchanged at about 2¼d. to 3d. per lb., delivered, according to quantity.

AMMONIA, MURIATE.—Grey galvanisers' crystals of British manufacture, quoted £23 10s. to £25 10s. per ton, ex station. Continental on offer at about £21 10s. per ton, c.i.f. U.K. ports. Fine white crystals of continental manufacture, quoted £18 5s. per ton, c.i.f. U.K. port.

ARSENIC, WHITE POWDERED CORNISH.—Spot material quoted £16 5s. per ton, ex store. Offered for early delivery at about £15 15s. per ton, ex store.

BARIUM CARBONATE, 98/100%.—White powdered quality quoted £6 15s. per ton, c.i.f. U.K. ports.

BARIUM CHLORIDE, 98/100%.—Rather higher quotations from the continent. Now quoted £9 5s. per ton, c.i.f. U.K. ports for large crystals. Spot material still on offer at about £10 10s. per ton, ex store.

BLEACHING POWDER.—English material unchanged at £9 10s. per ton, ex station. Contract 20s. per ton less. Continental on offer at about £7 10s. per ton, c.i.f. U.K. ports.

BARYTES.—English material unchanged at £5 5s. per ton, ex works. Continental quoted £5 per ton, c.i.f. U.K. ports.

BORAX.—Granulated, £22 10s. per ton; crystals, £23 per ton; powdered, £24 per ton, carriage paid U.K. stations.

CALCIUM CHLORIDE.—English manufacturers' price unchanged at £5 12s. 6d. to £5 17s. 6d. per ton, ex station. Continental on offer at about £3 17s. 6d. per ton, c.i.f. U.K. ports.

COPPERAS, GREEN.—In moderate demand for export, quoted £3 17s. 6d. per ton, c.i.f. U.K. ports. On offer for home consumption at about £3 10s. per ton, f.o.r. works.

COPPER SULPHATE, 99/100%.—Good inquiry for export. English material quoted £23 5s. per ton, f.o.b. U.K. ports; continental on offer at about £22 5s. per ton, ex wharf.

FORMALDEHYDE, 40%.—Rather higher offers. Now quoted £38 per ton, c.i.f. U.K. ports. Spot material quoted £39 10s. per ton, ex store.

GLAUBER SALTS.—English material unchanged at £4 per ton, ex store or station. Continental quoted at £3 per ton, c.i.f. U.K. ports.

LEAD, RED.—Imported material now quoted £37 10s. per ton, ex store.

LEAD, WHITE.—Quoted £38 10s. per ton, ex store.

LEAD, ACETATE.—White crystals offered from the continent at £44 per ton, c.i.f. U.K. ports. Brown now quoted £40 per ton.

MAGNESITE, GROUND CALCINED.—Quoted £8 10s. per ton, ex store, in moderate demand.

POTASSIUM CAUSTIC, 88/92%.—Syndicate prices vary from £25 10s. to £28 15s. per ton, c.i.f. U.K. ports, according to quantity and destination. Spot material available at about £29 per ton, ex store.

POTASSIUM BICHROMATE.—Unchanged at 4½d. per lb., delivered.

POTASSIUM CARBONATE 96/98%.—Quoted £25 5s. per ton, ex wharf, early delivery. Spot material on offer at £26 10s. per ton, ex store; 90/94% quality quoted £22 5s. per ton, c.i.f. U.K. ports.

POTASSIUM CHLORATE, 98/100%.—Powdered on offer at £26 15s. per ton, c.i.f. U.K. ports. Crystals, £28 per ton, c.i.f. U.K. ports.

POTASSIUM NITRATE (SALTPETRE).—Unchanged at about £22 5s. per ton, c.i.f. U.K. ports; spot material available at £24 per ton, ex store.

POTASSIUM PERMANGANATE, B.P. CRYSTALS.—Quoted 7½d. per lb., ex store, spot delivery. To come forward, 7d. per lb., ex wharf.

POTASSIUM PRUSSIATE, YELLOW.—Quoted 7½d. per lb., ex wharf, early delivery. Spot material on offer at 7¼d. per lb., ex store.

SODA CAUSTIC.—76/77%, £17 10s. per ton; 70/72, £16 2s. 6d. per ton; broken, 60%, £16 12s. 6d. per ton; powdered, 98/99%, £20 17s. 6d. per ton. All carriage paid U.K. stations, spot delivery. Contracts 20s. per ton less.

SODIUM ACETATE.—Quoted £20 10s. per ton, ex store, spot delivery. English material on offer at about £22 per ton, ex station. Continental to come forward quoted £19 15s. per ton, c.i.f. U.K. ports.

SODIUM BICARBONATE.—Refined recrystallised quality, £10 10s. per ton, ex quay or station. M.W. quality 30s. per ton less.

SODIUM BICHROMATE.—English price unchanged at 3½d. per lb., delivered.

SODIUM CARBONATE AND SODA CRYSTALS.—£5 to £5 5s. per ton, ex quay or station; powdered or pea quality, £1 7s. 6d. per ton more (alkali 58%), £8 12s. 3d. per ton, ex quay or station.

SODIUM HYPOSULPHITE OF SODA.—Large crystals of English manufacture quoted £9 per ton, ex store. Minimum 4 ton lots. Pea crystals, £14 10s. per ton, ex station. Continental on offer at about £7 12s. 6d. per ton, c.i.f. U.K. ports.

SODIUM NITRATE.—Quoted £13 per ton, ex store; 96/98% refined quality, 7s. 6d. per ton extra.

SODIUM NITRITE, 100%.—Quoted £24 per ton, ex store. Offered from the continent at about £22 5s. per ton, c.i.f. U.K. ports.

SODIUM PRUSSIATE, YELLOW.—Spot material quoted 4½d. per lb., ex store. Offered for early delivery at 4d. per lb., ex wharf.

SODIUM SULPHATE, SALTCAKE.—Price for home consumption £3 10s. per ton, ex works. Good inquiry for export and higher prices obtainable.

SODIUM SULPHIDE, 60/62%.—Solid, £13 5s. per ton; broken, £14 5s. per ton; flake, £15 5s. per ton; crystals, 31/34%, £8 12s. 6d. per ton. All delivered buyer's works U.K., minimum 5 ton lots, with slight reduction for contracts. 60/62% solid quality offered from the continent at about £9 15s. per ton, c.i.f. U.K. ports. Broken 15s. per ton more. Crystals, 30/32%, £7 per ton, c.i.f. U.K. ports.

SULPHUR.—Flowers, £11 10s. per ton; roll, £10 5s. per ton; rock, £10 5s. per ton; floristella, £9 15s. per ton; ground American, £9 per ton, ex store, spot delivery. Prices nominal.

ZINC CHLORIDE.—British material, 96/98% quoted £23 15s. per ton, f.o.b. U.K. port; 98/100% solid on offer from the continent at about £21 15s. per ton, c.i.f. U.K. ports; powdered, 20s. per ton extra.

ZINC SULPHATE.—Continental make on offer at about £11 per ton, ex wharf.

NOTE.—The above prices are for bulk business, and are not to be taken as applicable to small parcels.

Coal Tar Intermediates

H. ACID.—3s. 3d. per lb. per 100%. Some home inquiries.

NEVILLE AND WINTHER ACID.—4s. 9d. per lb. per 100%. Some home inquiries.

SULPHANILIC ACID.—9d. per lb. per 100%. Fair home inquiries.

BENZALDEHYDE.—2s. 1d. per lb. Some home inquiries.

ALPHA NAPHTHOL.—2s. per lb. Some home inquiries.

Manchester Chemical Market

[From Our Own Correspondent.]

Manchester, June 24, 1926.

The general conditions of the chemical-using industries, as a result of the pronounced scarcity of fuel, do not favour activity in the chemical market, and the experience here during the past week has been far from satisfactory. Buying for home consumption has been on a very restricted scale, and export demand, also, leaves plenty of room for improvement. A slight easing of prices is to be observed in one or two instances, but they are not important in themselves, and taking the market as a whole values are keeping remarkably steady.

Heavy Chemicals

For bleaching powder enquiry during the week has been limited, but there is no alteration in prices, £8 10s. per ton still being quoted. Saltcake continues to be a slow seller at about £3 5s. per ton. Although there is only a very quiet demand for acetate of soda prices keep up at £21 per ton as supplies of this material are not too plentiful. Caustic soda is firm and in fair request at from £15 2s. 6d. per ton for 60 per cent. to £17 10s. for 76 per cent. strength. Glauber salts are steady at about £3 15s. per ton, but not much business has been done in this. Sulphide of sodium is quiet and values have a slightly easy tendency, 60–65 per cent. concentrated solid offering at £10 10s. and commercial material at about £8 15s. per ton. There is a quietly steady demand for bicarbonate of soda at round £10 10s. per ton. Hyposulphite of soda also meets with some enquiry at £14 10s. per ton for photographic quality, and about £9 5s. 10r commercial. Phosphate of soda is rather easier at £12 5s. per ton, and not much interest in this is being shown at present. Bichromate of soda is maintained at about 3½d. per lb. Chlorate of soda is still on offer at 3¼d. per lb., but demand is rather quiet. Alkali keeps firm and in moderate request at round £6 15s. per ton.

As far as potash compounds are concerned bichromate seems to be rather scarce just now, and values show a firm tendency although not actually changed since last week at 4½d. per lb. Yellow prussiate of potash is attracting only a limited amount of interest, but prices are steady at about 7d. per lb. Carbonate of potash is about unchanged at £26 5s. per ton, with 90 per cent. caustic still offering at £27. Permanganate of potash is a slow seller at 5d. to 5½d. per lb. for commercial and about 7d. for pharmaceutical. Chlorate of potash is a quiet section and is now on offer at 3⅞d. per lb.

Arsenic continues to meet with a very limited demand, although quotations are fairly steady at about £13 10s. per ton, on rails, for white powdered, Cornish makes. Sulphate of copper is also relatively quiet at £23 15s. per ton, f.o.b. The lead compounds continue to be well held, nitrate still being quoted at about £41 per ton, and white acetate of lead at £45 to £46, with brown offering at round £40; demand in all cases, however, is not brisk. Acetate of lime is firm at about £16 per ton for grey material, and from £7 15s. to £8 for brown.

Acids and Tar Products

There is a quiet business being put through in acetic acid at steady prices, glacial being quoted at about £67 and commercial 80 per cent. at £36 10s. per ton. Oxalic acid, however, is still dull and easy at round 3⅝d. per lb. Citric acid is in fair demand, and prices are maintained at 1s. 3½d. per lb., with tartaric acid quoted at 11½d.

There is almost nothing at all being done in any of the coal-tar products as stocks are very low and no business can be arranged for forward. Pitch is nominally unchanged at 72s. 6d. per ton, while what little creosote oil is available is selling at high prices—anything from 6½d. to 7d. per gallon. For carbolic acid and solvent naphtha there is only a very slow demand although, at the same time, it should be said that very little is being offered.

Indicators and Flush-Front Meters

A large range of Bailey indicators and flush-front meters is supplied by Industrial Combustion Engineers, Ltd., of Astor House, Aldwych, London, W.C.2. The instruments include multi-pointer gauges, for the ready and accurate comparison of draught readings from various points in gas passages (indicating flow meters, low pressure gauges, high pressure gauges, temperature indicators and tachometers may be added to the multi-pointer gauge); boiler meters, for recording and totalising steam flow, etc.; indicating boiler meters. The Bailey flush-front meters and gauges have been specially developed to combine efficiency with neat appearance.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

Rotary Converters, etc.—The Director-General, India Store Department in London, invites tenders for rotary converters, 500 k.w., 250 volts, with step-down transformers. These are due on July 16 and July 20 (before 2 p.m.) respectively, and forms are obtainable from the Director-General, India Store Department, Branch No. 10, Belvedere Road, Lambeth, S.E.1.

Metallurgical Apparatus.—A manufacturer's agent in Brussels desires the representation, on a commission basis, of a British firm specialising in the construction and installation of special metallurgical apparatus and mechanical appliances. He would operate in Belgium and the Belgian Congo, and correspondence may be in English. (Reference No. 834.)

Linseed Oil and Red Lead.—A commission agent in Rio de Janeiro desires to get into touch with British manufacturers or exporters, with a view to their representation. (Reference No. 857.)

Edible Oils.—A firm in Valparaiso desires to obtain the agency of British manufacturers. (Reference No. 858.)

Gas Light and Coke Bill

The Select Committee of the House of Commons, Sir Park Goff presiding, concluded consideration on Monday, June 21, of the Gas Light and Coke Bill. The Bill seeks to confer on the Gas Light and Coke Co. additional borrowing powers of upwards of £4,000,000 and the fixing of a minimum dividend of 5 per cent. on the ordinary stock. Mr. Moon, addressing the Committee on behalf of the petitioners against the Bill, said if the Committee decided to give the company a minimum dividend, as in the case of the South Metropolitan Gas Co., then he would ask the Committee to apply the precedent of the South Metropolitan Company to the Gas Light and Coke Co. by distinguishing between the existing capital of the company and new capital.

The Chairman, after the consultation of the Committee in private, announced that they found the preamble proved. The Committee were also of opinion that any further issue of capital must be utilised for the repayment of funds borrowed from the special funds, including the superannuation fund and others.

Serious Shale Mining News

Scottish Shale Oils, Ltd., have resolved to abandon operations at the crude oil works at Dalmeny, West Lothian, and also the crude oil works and shale mines at Tarbrax, Lanarkshire, and to proceed at once with the dismantling of the plants. The abandonment of the works named will mean the permanent displacement of over 500 men, for whom it will be impossible to find work in the respective districts. Further, it is stated that the rates of wages at the works and mines at present in operation are to be reduced by 5 per cent. from the beginning of July, this reduction being in conformity with the findings of the Laing Committee. As a result of recent representations made to the Government it was hoped that the industry would receive such support by way of preferential contracts as would enable the company not only to continue operations over the whole of the shale field, but to avoid a further cut in wages. It is now feared, however, that the disastrous consequences to the country of the coal miners' strike have made it impossible for the Government to give anything like substantial aid to the industry.

Company News

INTERNATIONAL NICKEL CO.—A quarterly dividend of $50 on the common stock is payable on June 30.

BRITISH DYESTUFFS CORPORATION, LTD.—The directors have decided to pay a dividend of 2½ per cent. upon the new ordinary capital.

TEHIDY MINERALS, LTD.—An interim dividend is announced at the rate of 2½ per cent., less tax, on account of the year 1926, payable on July 31.

SAN SEBASTIAN NITRATE.—The net profit for 1925 was £3,299 and £8,045 was brought forward, making a total of £11,344, which it is proposed to carry forward.

CYPRUS ASBESTOS CO.—The operations for the year resulted in a slightly reduced debit balance to profit and loss account, which now stands at £27,697.

AMERICAN CYANAMID CO.—A dividend of 1½ per cent. on the deferred stock is announced, and 1 per cent. plus ½ per cent. extra on the common stock.

JOSEPH NATHAN, LTD.—The company announces a dividend of 3½ per cent. on the "A" 7 per cent. preference shares, for the half year ended December 31 last, payable on July 1.

MAGADI SODA CO., LTD.—The directors have decided to pay 5 per cent. on account of the 6 per cent. debentures for the year ending December 31, 1925. Payments will be made on June 29 to those debenture holders on the books on June 19.

MINERALS SEPARATION, LTD.—The profit and loss account for the year ended December 31 last shows a credit balance amounting to £24,908. The directors recommend a dividend at the rate of 10 per cent. per annum, less income tax, payable on June 30, 1926.

BRITON FERRY CHEMICAL AND MANURE CO.—The directors announce that in consequence of the adverse effect of the general and coal strikes upon business, they think it advisable to defer payment of the interim dividend on the 7 per cent. cumulative preference shares.

ANTON JURGEN'S VEREENIGDE FABRIEKEN (UNITED MARGARINE WORKS).—On and after July 1, the company is prepared to receive applications from shareholders desiring to split their holdings into sub-shares of the nominal value of Fl.12 (£1) each and to issue certificates in respect thereof.

CAPE ASBESTOS CO.—The net profit for 1925 amounted to £26,485 as against £18,325 in the previous year. The dividend on the ordinary shares is again 10 per cent., less tax. It is proposed to place £7,000 to reserve, against £2,250; the staff fund will receive £1,500, and £10,491 is to be carried forward.

UNITED WATER SOFTENERS, LTD.—The net profits for the past year were £13,716, and £1,543 was brought forward. Dividends of 2s. per share on the ordinary shares and on 11,111 new ordinary shares (ranking for half year's dividend only), tax free, are proposed, writing £4,250 off patents, licences, etc., and carrying forward £1,564.

SHIP CANAL PORTLAND CEMENT MANUFACTURERS.—The directors, in their report for the year ended March 31 last, state that, after charging all expenses, there is a balance remaining to the credit of profit and loss account of £93,442, out of which have been paid the two half-yearly dividends on the 7½ per cent. preference shares, absorbing £6,279. It is proposed to pay a dividend on the ordinary shares at the rate of 7½ per cent. per annum, less income tax, and to transfer £50,000 to depreciation account, leaving £23,663 to be carried forward.

ABERTHAW AND BRISTOL CHANNEL PORTLAND CEMENT CO.—In their report for the year ended March last, the directors state that the accounts show profits of £111,039, making, with the balance brought forward, an available sum of £176,463. After meeting interest charges, interim dividends, final preference dividend, debenture stock sinking fund instalment, £2,500, also transfer to reserve, £30,000, the directors recommend a final dividend of 9 per cent. on ordinary shares, making 15 per cent., less income tax, for year, carrying forward £72,713. The reserve fund is increased to £150,000.

New Chemical Trade Marks

Applications for Registration

This list has been specially compiled for us by Mr. H. T. P. Gee, Patent and Trade Mark Agent, Staple House, 51 and 52, Chancery Lane, London, W.C.2, from whom further information may be obtained, and to whom we have arranged to refer any inquiries relating to Patents, Trade Marks and Designs.

Opposition to the Registration of the following Trade Marks can be lodged up to July 16, 1926.

"ASKOL."

468,817. For raw or partly prepared, vegetable, animal and mineral substances used in manufactures, not included in other classes, but not including beeswax, bituminous emulsions, coal and dyes, and not including any goods of a like kind to any of these excluded goods. Class 4. Anglo-Scottish Chemical Co., Ltd., Bank of Scotland Chambers, 20, Renfield Street, Glasgow, C.2; manufacturers. April 9, 1926.

"STROT."

468,644. For wood preservative. Class 1. Stanley Haywood, 36, Queensgate, Bolton, Lancashire; chemist. March 31, 1926.

Opposition to the Registration of the following Trade Marks can be lodged up to July 23, 1926.

"DYECRETE."

469,769. For preparations of organic dyestuffs for colouring or tinting cement, concrete, and other building material. Class 1. Gerald Noel White, 7–8, Idol Lane, Eastcheap, London, E.C.3; consulting chemist. May 13, 1926.

"PHYLAXITE."

467,526. For a varnish for use as an anti-corrosive and for insulating purposes. Class 1. Frederick Foster, 4, Albert Mansions, 177, Stockwell Road, Brixton, London, S.W.9; engineer. February 25, 1926. (By consent.)

"MIN MAX."

468,195. For colours, distempers, paints and varnishes. Class 1. Leyland Paint and Varnish Co., Ltd., Northgate, Leyland, Lancashire; paint manufacturers. March 17, 1926.

"CIVIC."

469,111. For chemical substances used in manufactures and anti-corrosives. Class 1. City Glass Co., Ltd., 167, West Graham Street, Charing Cross, Glasgow, C.4, and 90, Jermyn Street, London, S.W.1; merchants and manufacturers. April 17, 1926. (To be associated. Section 24.)

Tariff Changes

AUSTRALIA.—The Power Alcohol Bounty Act (No. 11 of 1926) provides, under certain conditions, for the payment of a bounty of 4d. per gallon, for power alcohol produced in Australia and delivered from the control of the Customs during the period commencing on January 1, 1927, and ending on December 31, 1931.

CANADA.—Applications have been made to the Tariff Advisory Board by manufacturers of Epsom salts for a bounty on their production, or a specific duty on imports.

BELGIUM.—Certain amended and modified duties coming into force, as from June 14, include customs duties on hydrogenated fish oils and fats, refined and distilled glycerine, soap, animal and vegetable oils, etc. Revised duties on petroleum, schist, lignite and other similar oils will operate from July 2.

ECUADOR.—Revised customs duties on imported goods are to come into force on July 1.

POLAND.—Manganese ore and ferrosilicon containing more than 15 per cent. of manganese or silicon, imported under permit from the Minister of Finance, are now subject to the full Tariff rate of 9 zlotys per 100 kilos.

ROUMANIA.—A Decree effective from June 5 modifies the import duties on metallurgical goods, and in many cases considerably reduces the rates.

SWEDEN.—A Swedish Royal Decree dated May 7, gives effect in Sweden to Article 10 of the International Convention for the Simplification of Customs Formalities, and provides, under certain regulations, for the duty-free importation of samples and specimens by manufacturers and traders either personally or through the agency of commercial travellers.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

County Court Judgments

[*NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.*]

RILEY REUBEN, D. F., The Anchorage, Whalley Road, Clayton-le-Moors, chemical manufacturer. (C.C., 26/6/26.) £24 18s. 7d. May 22.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

FELL (THOMAS) AND CO., LTD., London, W.C., perfume manufacturers. (M., 26/6/26.) Registered June 11, £100 debenture, to W. E. Leveson-Gower, 235, High Holborn, W.C., accountant; general charge. *Nil. December 31, 1925.

HEPPELLS, LTD., London, E.C., chemists. (M., 26/6/26.) Registered June 9, collateral security and further charge to F. J. M. Pyne and another, 15, Lombard Street, E.C., bank managers, securing all moneys from time to time owing in addition to £18,000 remaining owing under principal deed dated December 22, 1924; charged on properties at Mitcham, etc. *£48,000. October 26, 1925.

HEYL'S COLOURS, LTD., Luton. (M., 26/6/26.) Registered June 8, £14,000 mortgage of charge, to Nevile Foster and Co., Ltd., 15, Throgmorton Avenue, E.C.; charged on land in Windmill Road, Luton, also general charge. *£15,000. October 26, 1925.

TAMPICO OIL LTD., London, W.C. (M., 26/6/26.) £255 debentures, part of £50,000; general charge. *£52,745. January 1, 1926.

Satisfactions

DAY (JOB) AND SONS, LTD., Leeds, engineers and soap manufacturers. (M.S., 26/6/26.) Satisfaction registered June 12, £300, part of amount registered May 21, 1926.

PHARMACISTS' MUTUAL SUPPLY ASSOCIATION, LTD., Newton Abbot. (M.S., 26/6/26.) Satisfactions registered June 10, £3,500, registered November 12, 1923; and £250, part of amount registered November 30, 1923.

WATERMAN (G.) LTD., Croydon, dyers. (M.S., 26/6/26.) Satisfaction registered June 16, £1,500, part of amount registered May 13, 1926.

Receivership

GREENGATE COLOUR WORKS, LTD. (R., 26/6/26.) C. T. Wood, of 69, Corporation Street, Manchester, was appointed Receiver on June 3, 1926, under powers contained in first mortgage debenture dated August 17, 1921.

London Gazette, &c.

Company Winding Up

FOX AND CO. (CHEMICALS) LTD. (C.W.U.V., 26/6/26.) Winding up Order, June 16.

Notice of Intended Dividend

BOOTH, Thomas Arthur, Louisa Street, Idle, Bradford, wholesale manufacturing druggist. Last day for receiving proofs, July 3. Trustees, A. B. Thoesby, Arthur Bertram, Palmerston Buildings, Manor Row, Bradford, and F. Gill, 2A, Tyrrel Street, Bradford.

New Companies Registered

DAPPER DYES, LTD., 33, Bath Street, Glasgow. Registered in Edinburgh on June 19, 1926. Manufacturers and dealers in water soluble dyes, etc. Nominal capital, £2,000 in £1 shares.

SALERMO, LTD., Imperial House, Kingsway, London. Registered on June 19, 1926. To acquire and turn to account processes for the low temperature carbonisation of fuels and bituminous substances, processes for the treatment and distillation of tars and heavy oils, etc. Nominal capital, £75,000 in £1 shares.

Latest Government Contracts

RECENT Government contracts placed by the various departments include the following:—

Admiralty

Distilling Plant: P. and B. Evaporators, Ltd., Middlesbrough.

War Office

Acids: Spencer Chapman and Messel, Ltd., London; Chlorine: United Alkali Co., Ltd., Widnes; Linseed Oil, Raw: Langley Smith and Co., London. Methylated Spirit: Jones and Co. (Methylators), Ltd., London. Oil, Valvoline: Valvoline Oil Co., Liverpool. Gas Producer Plant: Power Gas Corporation, Ltd., Stockton-on-Tees.

Air Ministry

Luminous Compound: F. Harrison Glew, London. Paint, Lead, White: Mersey White Lead Co., Ltd., Warrington. Soda, Caustic: Brunner Mond and Co., Ltd., Northwich.

Post Office

Oil, Colza: Jas. Arnott and Sons, Ltd., Newcastle-on-Tyne. Oil, Kerosene: British Petroleum Co., Ltd., Llandarcy and Grangemouth.

Crown Agents for the Colonies

Cement: The Cement Marketing Co., Ltd., London. Concrete Mixers: Stothart and Pitt, Ltd., Bath. Laboratory Apparatus and Chemicals: Baird and Tatlock, Ltd., London. Paint: Mersey White Lead Co., Ltd., Warrington. Ice Making Plant: The Pulsometer Engineering Co., Ltd., London. Tar: J. Miller, Son and Co., Ltd., Glasgow.

H.M. Prison Commission

Drugs and Sundries (half year): C. S. Hewlett and Sons, Ltd., London.

Soda and Dermatitis

A CASE in which it was alleged that strong soda water had set up dermatitis was heard in the Shoreditch County Court, on Tuesday, before Judge Cluer, when Samuel Henry Taylor, of 15D, Peabody Buildings, Cambridge Circus, E., a potman, was the applicant in a Workmen's Compensation Act claim, the respondent being Maud Pye, of 483, Hackney Road, E., a licensed victualler. The man had had to use strong soda water for cleaning purposes, and contracted dermatitis of the hands and arms, caused by the soda. He was certified fit on September 14, 1925, and he returned to work, but on February 26 of this year, the dermatitis recurred, owing to the action of the soda. He had now once again been certified fit for work, with the proviso that he was not to handle soda water or soda in any form. He had in all received £26 16s. 11d. in compensation, and Mr. R. M. Cluer, who appeared for the respondent, said an offer had been made to settle the matter for £30 with £7 7s. costs. The applicant was willing to accept this, but the Registrar had refused to agree on the ground of inadequacy. The judge remarked that the applicant must have a very sensitive skin, as there were hundreds and thousands of servants who used strong soda water daily, but did not contract dermatitis. Mr. R. M. Cluer pointed out that the scope of possible employment for the applicant was very wide as he was only prohibited from handling soda or soda water. The judge said that there were other difficulties, because people might refuse to work with him as he had got or had had dermatitis. He could agree to this settlement if the applicant got work, but not before. He thought the Registrar was right, and refused to alter the decision of the latter.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Metallurgy and its Influence on Modern Progress

Sir Robert Hadfield's New Book

ALTHOUGH iron has been known and used for at least two thousand years, as witness the fact that Aristotle in 322 B.C. described the manufacture of Indian steel, the remarkable developments in its metallurgy are of very recent origin, as Sir Robert Hadfield shows in the admirable book* which he has just published. It was not until the decades of 1870 to 1890 that there occurred the great advances and activity in metallurgical science that have rendered possible the modern progress in engineering, with all that it means to civilisation. The author, whose early work may be said to have inaugurated the era of special steels, has been so closely associated with this advance that his touches of personal biography almost constitute in themselves a history of the science. Sir Robert Hadfield offers the volume as a "tribute to some of the more notable early workers" and "an incentive to younger men," and the reader cannot fail to share some of the emotions of the pioneer as he reads of the discovery of these momentous materials.

Early Literature

It is interesting to note that Shakespeare refers to iron and steel over one hundred times in his writings, having, it appears, some knowledge of metallurgy from his friendship with Thomas Russell, who took out patents in 1609 for extracting metal ores. For over two centuries later, however, there was little metallurgical literature of real value, and even from 1860 to 1875 few important works were published, excepting, among others, Kohn's *Iron and Steel Manufacture*. This was not to be wondered at, as analytical and mechanical tests were as yet in their infancy, while metallography was unknown. Considering the progress of the last fifty years generally, and chiefly during the present century, it can be correctly said that no branch of science, except perhaps electrical engineering, has advanced so rapidly as metallurgy has done.

The first serious appreciation of the importance of ferro-alloys appears to have been made by Berthier, who recorded, in the *Annales de Chimie* of 1821, that he prepared ferro-chromium, not solely because he believed such material had in itself any special value, but because he thought it would be found useful as a means of introducing chromium into cast steel. This investigator acknowledged that the idea was suggested to him by Faraday's paper on alloying different metals with steel, and it is of interest that, had the significance of this early work been appreciated, the history of special steels might have begun much earlier than was actually the case.

Discovery of Ferro-Manganese

In 1868, ferro-manganese is reported to have been made by Henderson at his iron works at Glasgow, but it was not until ten years later that the new alloy was made available by the blast furnace practice of the Terre Noire Co., in France, who exhibited specimens at the Paris Exhibition in 1878. This marked the beginning of Robert Hadfield's work on special steels, for, although only twenty years of age, he made a translation of the pamphlet issued to describe these exhibits, and this, he records, probably made the impression that inspired him to carry on the series of investigations on iron alloys which finally resulted in the invention of manganese steel.

In his experimental note-book there is the following entry under the date of September 7, 1882: "I was led to make the following experiments with a view to the production of a very hard steel for tramway wheels, and grinding wheels to be used in the place of emery wheels. The experiments have led to some very curious, perhaps most momentous, results that may to some extent entirely revolutionise metallurgical opinions as regards alloys of iron and steel." An order had been executed in the foundry of his father's steel works at Sheffield for a pair of cast steel rolling mill pinions, which, however, were found to be constantly "seizing" and were running, in fact, "as if sand had been poured between the teeth"! Analysis showed that 1·5 per cent. of silicon was present in the steel, due to incorrect heat treatment, and this led Hadfield to think that this quality might be employed to advantage for other purposes. It must not be supposed, however, that his invention was perfected without much laborious investigation, though the actual discovery of his remarkable steels appears to have been arrived at in some degree by chance. It is said that blotting paper was discovered only when some paper, in which the size ingredient had by accident been omitted, was used to wipe up some printer's ink; Hadfield, at any rate, melted together some scrap iron with silicon spiegel, the latter being a ferrous alloy also containing manganese. The resulting material did not possess the qualities desired but, while the experiment was practically a failure so far as its primary result was concerned, it led to the discovery of manganese and silicon steels.

Recognition of Invention

It was not for a good many years, however, that the importance of these new materials was fully recognised, perhaps even by their inventor himself; for in 1892, some ten years after the discovery of manganese and silicon steels, Sir Robert Hadfield stated in a paper to the Iron and Steel Institute: "The author cannot but think that the question of steel alloys will be eventually found to possess considerable practical importance to the world at large, and perhaps be the means of eventually enabling our civil and mechanical engineers to design and carry out works of a magnitude which, notwithstanding the great strides made during the last few years, even at present are not possible." It was not until 1906, twenty-one years after its discovery, that his firm produced even a ton of special silicon steel to be dealt with commercially in this country for use in electrical apparatus, this also being the case with manganese steel, and it is only now that the value of these special steels is being recognised to the fullest extent. Modern engineering construction demands high tenacity materials, for which purpose alloy steels possessing toughness and ductility are most suitable, while serious attention is now being directed to them for structural work, owing to the annual loss due to corrosion and other factors.

It is impossible here to touch on more than a few of the interesting subjects dealt with by Sir Robert Hadfield. Enough has been said, however, to indicate both the personal and scientific interest of a volume that will be welcomed equally by the metallurgist and the general reader.

*METALLURGY AND ITS INFLUENCE ON MODERN PROGRESS. By Sir Robert Hadfield, Bt., F.R.S. London: Chapman and Hall. 388 pp. 25s.

The Metallurgical Aspects of Modern Boiler Practice

By L. P. Sidney

We have often been accused, as a nation, and in the past, with extravagance in regard to the use of the coal with which nature had so abundantly provided us. "Thriftless" would perhaps have been the more appropriate term. Coal was cheap and plentiful in those days, and while it may be admitted that much of it was—and still is being—consumed wastefully, there was no very strong incentive towards any great extent of economy in its use. The cost of the devices for making a ton of coal go farther were often not, in view of its cheapness, justified on the grounds of capital expenditure. Hence only the least costly and most obvious of such devices were adopted. They comprised the use of waste—but usually uncleaned—blast furnace gases in boilers; economisers, moderate superheating, and feed water heaters; mechanical stokers installed more for the purpose of saving labour than of saving fuel, and rule of thumb practice in regard to chequer work in stoves and regenerators. The steam turbine employed nothing like the temperatures and pressures now found to be practicable or advisable, and so far as internal combustion engines were concerned, British experience in pre-war days can hardly be said to have been either happy or profitable.

Factors of the Problem

Conditions have since then become so radically altered that fuel economy, which means in the end the production of cheaper power, is to-day the paramount necessity in industry. Our boilers, turbines and engines have to be driven with an intensity not dreamed of by the pioneers of steam engineering. The problem to be met is the provision of super-materials for boiler work to sustain increasingly high pressures and temperatures, and materials for turbine and internal gas engine construction which shall not only sustain such higher pressures and temperatures, but the corrosive and erosive action of high temperature and corrosive fluids. Further, the problem is one of economising, not fuel alone, however desirable this object, but the iron and steel and other metallurgical materials employed in engineering design and construction. Nature takes a heavy toll of the iron and steel used, and this constitutes an unduly high proportion of the ultimate cost. Sir Robert Hadfield has repeatedly pointed out the ruinous effect of corrosive agencies in the depreciation and destruction of these materials, and has estimated the annual loss at no less than £500,000,000 per annum in respect of iron and steel alone. The protection of materials from corrosion, or better still, the addition of alloy metals which will enable iron and steel to withstand corrosion, is therefore but one aspect of the general problem involved.

Boiler Pressures and Temperatures

It has been necessary to state, on somewhat broad lines, the chief features of the problem, in order to ascertain the way in which it should be attacked. The question of corrosion is, however, outside the scope of this article, which deals with the narrower aspects of the material required in boiler practice.

The tendency, as has been seen, is mainly in the direction of employing increasingly high temperatures and pressures. So far as metallurgy is concerned the questions are: (1) How far are existing materials capable of withstanding such high temperatures and pressures? and (2) to what extent can they be improved upon, with these objects in view.

In a boiler shell, and to an extent probably even greater and more complicated in the headed tubes of high pressure boilers, the high pressure of the contained fluid at high temperatures reinforces the strain on the metal consequent on its normal coefficient of heat expansion. The stresses are circumferential (the hoop stress) and longitudinal. Both are, in the main, tensile stresses complicated by the usual components of tensile stress in such circumstances, but they are simultaneously exerted at right-angles to each other (longitudinal and transverse); the hoop stress having double the intensity of the longitudinal stress. In a steel pipe 4 in. in diameter, and having walls of ½ in. thick, with steam at 100 lb. pressure, the hoop stress is 800 lb. per square in., and if the ends are flanged the pressure on the bolts is rather more than 1,000 lb. per square in. In thick-walled containers under vastly higher pressures the stresses become much more complicated and severe in a proportion which increases functionally with the variable factors involved. The present probable theoretical limit of practicable steam pressure is 3,158 lb. per sq. in., absolute, at 705° F. (1·56 tons per sq. in., at 374° C). In such circumstances there is but one phase involved; there is no demarcation between liquid water and steam, and the latent heat of the latter falls to zero.

Elasticity and Viscous Flow

The calculation of the resulting compound longitudinal and transverse stresses in the material, under such conditions, being dependent upon a large number of variables—amongst which are the chemical composition of the steel used, the thickness of the metal, etc.—is a complicated mathematical operation, the data of which are sometimes vague and indeterminate, and sometimes actually lacking so far as useful purpose is concerned. It is obvious, however, that stresses of a very high order will be involved, probably well in excess of the elastic limits of those classes of steel usually employed in normal boiler practice; high enough, in any case, to reduce the usual "factor of safety" allowed to zero, or even a minus quantity. There are, moreover, great and serious objections to basing calculations as to the behaviour of metals at high temperatures upon determinations of the so-called elastic limit, or still more so on the yield point, maximum strength, breaking stress, or any of the multifarious alternative criteria of behaviour, as deduced from short time test-house results at normal temperatures, or short, high temperature laboratory tests, even at the working temperatures involved. It is not by any means certain how steel behaves at high temperatures, nor at what temperatures any particular steel begins to behave differently to its normal behaviour at normal temperatures. It has been fairly well established that between, say, 200° C and 350° C. an ordinary 0·30 per cent. carbon steel of otherwise normal composition exhibits greater tensile strength than at ordinary temperatures, while at the same time its ductility diminishes. On the other hand its behaviour between 350° and 500° C. is by no means as well established, some authorities regarding it as weaker within this range, and others believing that its maximum strength occurs somewhere between 350° C. and 450° C. It is, however, very generally agreed that, from 500° C. upwards, its strength, as measured by tensile stresses, falls off rapidly.

It cannot be too often emphasised, in this connection, that as regards static stresses (such as those under consideration) and dynamic stresses alike, the whole question of ultimate elasticity is inseparably bound up with the time factor. That steel has, within limits, a property of recovery is shown by the fact that mere immersion in boiling water will "restore" it, in the sense of raising the limit of proportionality, after an initial stressing beyond the yield point. The very meaning to be attached to these terms is, however, confused and often ambiguous, as they may mean different things according as they are employed by different authorities. In actual point of fact, it is regarded by many eminent physicists as by no means improbable that *any* stress, however small, may leave a slight permanent set. If this be so, elasticity becomes a very relative term; the only class of material to which Young's highly theoretical modulus of elasticity could, if applicable, be applied, would appear to be bodies such as pitch and indiarubber, to neither of which the term "elastic" can properly be applied at all. The stretching of indiarubber is, of course, a phenomenon differing entirely from the elongation of pitch. The whole question of the behaviour of metals, particularly at temperatures beyond the normal, involves, indeed, conditions the exact opposite of those embodied in the classical conception of elasticity; namely, plasticity and viscous flow. Their intrusion vitiates all calculations as to "safety limits" derived from tests carried out during short periods, on the so-called elasticity of metals. Concerning such properties our knowledge is severely restricted, and based, for the most part, on theories not easily reconcilable.

By far the best practical contributions in recent years to the study of steel and steel alloys at high temperatures are

the work carried out by Mr. J. H. S. Dickenson, and described in a paper read before the Iron and Steel Institute,* and the symposium held on the general subject of the heat-resistance of metals by the American Society for the testing of materials† to which an excellent bibliography of the subject is attached.

Determinations of Flow

Dickenson's experiments are particularly noteworthy, for he laid great stress on the time-factor, and some of his tests lasted for a continuous period of nine months. His method was to employ a constant load of 8·5 tons per square inch, and to record the length of time during which his specimens were able to sustain that load without breaking. The load in question is well within the order that would operate in the case of the employment of the critical pressures towards which modern boiler practice is tending. A carbon steel (0·30 per cent. C.) containing 0·51 per cent. of nickel, and 0·14 per cent. of chromium, sustained the load for 1,739 hours undamaged at 500° to 550° C., and its endurance was estimated at 3,400 hours. On the other hand, a nickel-chromium steel (carbon 0·25 per cent., Ni. 3·63 per cent. and Cr. 0·55 per cent.) failed, within the same temperature range, after 701 hours. The actual maximum (as distinct from the estimated maximum) was attained by a nickel chromium alloy (iron not given, but presumably below 13·0 per cent.), which withstood 600°–650° C. for 6,041 hours (nearly nine months). A 0·45 straight carbon steel gave indifferent results, its estimated period being 2,600 hours. The estimated period of a 14·7 per cent. chromium steel (carbon 0·26 per cent., nickel 0·39 per cent.) was 10,000 hours. The temperature in question is far higher than a boiler steel, or, for the matter of that, a turbine steel would be called upon to undergo, and while only assumptions can be made from Dickenson's experiments, it may be said that, dismissing the nickel-chromium alloy as being far too costly a material to use in boiler practice, it would appear that a carbon steel with suitable low amounts of nickel or chromium, or both, might be successfully expected to stand the requisite temperatures and pressures. The 0·30 per cent. carbon steel was, however, submitted to a scaling test at the same temperature range, the test lasting four days. In these circumstances, it lost 2 per cent. of its weight. Even allowing for a much slower rate of corrosion, due to the protective action of the earlier coats of scale formed, such a steel could not have a very long life. On the other hand, opinions are divided as to the protective action of oxide coatings. Secondary reactions may take place leading to accelerated rather than retarded corrosion.

Chromium and Nickel in Boiler Plates

The experiments of Dickenson, while comparatively few and not in every respect conclusive, are exceedingly valuable, for their results are borne out by practically all investigators who have studied the matter. The general concensus of opinion is that the strength of boiler plate can be satisfactory increased by the use of high quality steel containing certain, as yet undetermined, amounts of nickel and chromium. Where, however, tensile strength is of less importance than ability to withstand corrosion, the influence of nickel is, according to all accounts, either negligible or actually unfavourable. Chromium alloys not containing nickel behave far better. Here again, the question of cost looms large.

The question as to whether the boiler quality materials currently in use can be employed for the intensive pressures and temperatures of the future must therefore be answered in the negative. On the other hand, abundant evidence is forthcoming that by the use of additional non-ferrous metals, of which nickel, chromium and tungsten are the most suitable, boiler material having the necessary resistance to viscous flow, to withstand the temperatures and pressures of the boiler practice of the future, will be forthcoming. There is little prospect of its being cheap; on the other hand, if it serves its purpose well, and exhibits the properties of endurance and corrosive resistance which will be expected of it, it may in the long run prove cheaper for the purpose than its actual first cost would, at the present moment, make it appear. Industry can afford to pay twice as much for materials that lasts twice as long as those in ordinary use.

* *Journal of the Iron and Steel Institute*, 1922, No. i, p. 103.

† *Transactions* of the American Society for Testing Materials, Vol. 5, 1924.

The Casting of Aluminium Alloys

Practical Notes on the Process

Of the many alloys used for castings, those of aluminium are now attracting much attention as substitutes for brass and bronze. The ease with which these alloys can be prepared in ordinary kettles or iron pans is largely responsible for the favour they find in small workshops, the preparation not requiring any great experience in the metallurgy of the metals used, while the mixing or blending is a comparatively simple matter.

The strength of the aluminium itself is not great, as the crystals of the metal are large, this usually denoting weakness, but by adding metals which will break up these crystals to much smaller ones, a stronger metal is produced. Although copper reduces the size of the crystals, the strength is not greatly increased, but the addition of zinc as well gives the alloy a high tensile strength.

Among the troubles experienced in the casting of these alloys the weakness produced by using up old cast metal, wasters, gates, risers, etc., must be mentioned. The cause of this is that all zinc and aluminium alloys, on remelting, show a great increase in the amount of oxide inclusions, and slaggy castings therefore result. Incidentally, an increase in the amount of oxide of zinc and aluminium means an increase in the loss on remelting. All old "scrap" should be remelted with fluxes and cast into ingots, whereby the large bulk of the oxide is removed in skimming, and the refined ingots can then be used for making the castings. Various fluxes are used for the refining, the most common being zinc chloride.

Preparation of the Alloy

The first step consists of preparing a preliminary alloy of copper and zinc, and then mixing it with several times its weight of aluminium, this work being conducted in a small plumbago crucible heated on a pit fire. An analysis is taken of the preliminary alloys, which may contain, say, 20 per cent. of copper and 15 per cent. zinc. The metal is poured into ingot moulds and stored for the future production of numerous aluminium alloys. This method of working is the most satisfactory in the long run, as the preliminary alloy is capable of being used for various purposes, and also less aluminium is burnt off. It need scarcely be mentioned that the metal must be free from lead, otherwise segregation will occur when the casting cools.

In regard to the kettles or pans used for melting, it should be added that few founders pay sufficient attention to the metal of which these appliances are made. The iron for this purpose should have a high percentage of carbon and as low a percentage of silicon and phosphorus as possible. If the alloy does not require to be heated to too high a degree this gives it less opportunity to combine with the iron. The surface of the pot should be as smooth as possible, otherwise there is a risk of part of the iron being occluded, while the surface of the molten metal must be completely protected from the direct action of the flames of the fire. As iron is capable of producing detrimental effects on the castings of aluminium alloys, every care must be taken to prevent this impurity being present. The layer of crust that is formed after several charges have been melted protects the alloy from the intrusion of iron to a large extent. To prepare an alloy of any desired composition, the preliminary alloy is weighed out and melted first, after which bars of aluminium are added in the required proportions.

Various moulds are preferred for this class of work, these being heated prior to pouring the metal, as this gives the casting more time to cool uniformly. This heating of the moulds should not be sufficient to cause the molten alloy to cool slowly, as this results in coarse crystals, which are much weaker, being formed. The alloy in the melting pot, which is covered with a layer of grease, tallow or cheap oil to prevent oxidation, is poured into the mould at as low a temperature as possible (within certain limits). This gives the cast alloy a finely crystalline structure, and if the cooling has taken place rapidly the tensile strength is increased. In casting, the mould should be turned on one side as far as possible, so that the molten metal flows against the walls of the moulds, allowing the air to escape. Best results are secured by pouring continuously until the mould has been filled, this preventing the formation of oxide films.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Government and the Steel Industry

THE Government's decision with regard to the application of the iron and steel trades for the appointment of a "safeguarding committee" was announced by the Prime Minister last week, before the prorogation of Parliament for the Christmas recess. The application had been referred to the Committee of Civil Research, Mr. Baldwin stated, which had given the subject prolonged and detailed consideration, hearing a large number of witnesses, representing employers and employed engaged in the iron and steel and allied trades. The evidence revealed a serious situation, the pressure of foreign competition being severely felt by manufacturers, and had the Government been able to deal with the iron and steel industries in isolation, the case for inquiry might have been regarded as complete. It became clear, however, in the course of investigations that the safeguarding of a basic industry of this magnitude would have repercussions of a far wider character, which might be held to be in conflict with the Government's declaration in regard to a general tariff. In all the circumstances of the present time, the conclusion had been reached that the application could not be granted, although the Government would keep these industries under close observation, with a view to promoting their well-being should any other measure be deemed desirable. It was hoped that the loan for railway development in East Africa, which was recently approved, would be helpful, and further similar projects were under consideration.

Tantalum for Chemical Engineering

A STATEMENT just issued by the American Chemical Society outlines the possibilities of tantalum as a new material for chemical engineering, owing to its remarkable corrosion resisting properties. As a result of research undertaken at Ohio State University by Professor James R. Withrow, head of the Department of Chemical Engineering, it is found that tantalum lasts 1,600 times as long as platinum, and is very much cheaper. While the chemist looks upon platinum as one of the most resistant metals to corrosion, its use in jewellery is damaging chemical engineering research, and it has largely disappeared from manufacturing apparatus in the chemical industries.

Tantalum has not yet shown any value as a catalyst, but is almost as valuable in resistance as platinum-iridium, one of the most resistant alloys known. For instance, platinum is found to lose one gram per 100 sq. cm. in electrolytic corrosion in 60 hours, while tantalum requires 100,000 hours for the same loss, and platinum-iridium 125,000 hours. The half life of a No. 27 Birmingham wire gauge of cathode thickness of platinum was 114 days, whereas tantalum would only be one-half gone at the end of 525 years, and platinum-iridium at the end of 656 years. In spite of this great saving, tantalum is much less expensive in first cost than platinum. While platinum-iridium now costs in America about £866 per kilogram, and platinum £800, tantalum sheet can be obtained for £50 per kilogram. No one seems hitherto to have made such comparisons of the wastage of these materials, but if tantalum investigations continue to be favourable, a great contribution to chemical engineering will be made.

Light Alloys for Aeroplanes

THE decision now reached by the Air Ministry to abandon the use of wood in aeroplane construction will give further stimulus to the research and investigation of light alloys. The paper read by M. De Woitine at the recent meeting of the Institution of Aeronautical Engineers shows to how great an extent other countries are alive to the advantages of such alloys in aeroplane construction. Practice is far ahead, in this respect, on the Continent, in America, and even in Japan, of the methods hitherto employed in this country. M. De Woitine specially emphasised the point that in a heterogeneous structure of wood and metal it was impossible to adopt any generally applicable safety factor, and that this necessitated the employment of factors which, taken all round, were unduly high, and led to the average weight of the parts being unduly heavy. The metal for which French engineers display a marked predilection is duralumin. It is being used for the wings and the fuselage, and appears to possess satisfactory properties of resistance to the alternating stresses which wing parts have necessarily to undergo, as in actual trials abroad no play or failure of rivets have occurred, and the structure remains rigid. This, of course, tends greatly to reduce the severity and frequency of such alternating stresses. It is evident that British designers are now becoming convinced of the advantages attending the use of duralumin, since the Kingston flying boat has had its hull built up of sheets of this metal, and the dangers of corrosion, to which this material is regarded as being specially prone, have been found in practice to be far less serious than had been anticipated. It should be remembered that duralumin, while being the name of an alloy containing aluminium, copper, magnesium, and manganese as its essential constituents, varies somewhat widely in regard to the actual proportions of these metals present, and may be regarded as the name of a group of alloys rather than as that of any one of them. Its properties and, in particular, its tensile strength vary as widely. Amongst the duralumin group may be included the interesting series of metals examined by the National Physical Laboratory; the "Y" and "E" alloys containing nickel, etc., The following table shows some of the extreme variations of metals which may be regarded as belonging to the duralumin group, the "A" alloy (Cu 3·0 per cent.; Zn 20·0 per cent.) described by Dr. Rosenhain being omitted as varying, in respect of its zinc content, too greatly from others of its class:—

	Percentage.	
	Min.	Max.
Aluminium	93·0	96·6
Copper	0·5	4·5
Magnesium	Nil	1·5
Nickel	Nil	2·0
Zinc	Nil	0·8
Manganese	Nil	1·47
Iron	Nil	1·8
Silicon	Nil	0·6

Within this very wide range of composition, heat-treatment can develop a tensile strength up to 40 tons per square inch on some "rolled" metals.

A New Russian Alloy

A LIGHT aluminium alloy, the exact composition of which is not revealed, but which is stated to consist of aluminium, with small percentages of copper, nickel manganese and magnesium, and has been named "Koltchougalumin," is described in the Russian periodical, *The Industrial Metals Messenger*, by V. Boutaloy, who was instructed by the Soviet Department of Science and Technology to prepare an alloy which should resemble duralumin. Its specific gravity is 2·8, which is heavier than aluminium, from which it may be concluded that the percentage of magnesium present is fairly low. It gives a tensile strength of 60 kilogrammes per square millimetre (over 38 tons per square inch). It approximates therefore to some of the highly interesting aluminium alloys described recently by Dr. Rosenhain and Mr. Archbutt. It can be cast with the utmost facility into intricate patterns, which is more than can be said for aluminium itself, or for some of its alloys, and can be rolled while still hot but without requiring further reheating. It can also be drawn or forged. Heated to 500° C., and rapidly quenched, it hardens, and its other mechanical properties become subject to "age improvement," the period for their maximum development being some eight days or so. This again resembles the behaviour of some of Dr. Rosenhain's "age-hardening" alloys. The metal should be melted at as low a temperature as possible, and zinc chloride is employed to eliminate the slag which occurs, and so cleanse the metal. The magnesium is introduced, as an addition, just before tapping. Piping can be avoided by rapid pouring. Even when remelted a number of times no loss in magnesium is sustained. When for any reason it is not possible to roll the ingots down at once, they should be reheated between 400° to 450° for six or eight hours. The reason for this prolonged soaking does not transpire; possibly some degree of segregation occurs if too short a time be allowed. For heavy draughts

and in wire drawing, the metal requires to be annealed from time to time. In the case of sections, tubes, etc., the metal is placed for some minutes in a tepid 10 per cent. caustic soda solution, rinsed with water and then plunged into strong nitric acid, or aqua regia, for some minutes, whereupon it assumes a mat surface.

Manganese in Slags

THE strength of iron-portland cement, the name which serves to distinguish blast-furnace slag cement from the natural varieties, is said to fall in proportion to the amount of manganese present. A number of experiments made in Germany appear to support this contention. An ordinary blast-furnace slag, from a furnace making foundry iron, was purposely enriched with manganese dioxide by fusion in a Helberger electric furnace and a series of melts, the manganese proportion of which varied from 1 per cent. to 10 per cent., was thus prepared. The homogeneous mixtures were ground down and mixed with 25 per cent. of the unaltered original slag, and the resulting cement subjected to both tensile and compressive tests. All the slags thus prepared had a vitreous appearance ; yellowish granules occurred when the manganese percentage exceeded 3 per cent., and with 10 per cent. present the slags were yellow throughout. The presence of manganese appears to set up a condition of crystallisation which is unfavourable to the strength of the resulting cement. The whole question of manganese in slags is exceedingly interesting, both from a metallurgical and from an economic point of view, and quite apart from their alleged effect on cement. In the late war, as is well known, the Germans, in the absence of the supplies of ferro-manganese and spiegel required in ordinary open-hearth and Bessemer practice, were compelled to have recourse to old blast-furnace slag tips, and use the slags for the sake of percentages of manganese not deemed worthy of recovery in peace times. In Great Britain, at at least one large steel works where the practice is highly efficient and up-to-date, the metal mixer slags, that are fairly high in manganese, are charged back again to the blast-furnace, where they find their way into the pig iron which, in turn, yields it back in the mixer. A useful circulation is thus established which, to a considerable extent, obviates the necessity of charging expensive manganese or manganiferous ores into the blast-furnace in order to secure sufficient of this indispensable element in the resulting pig iron.

Pearlitic Cast Iron

THE progress made in non-ferrous metal work should not blind us to the fact that ferrous metallurgy is making equal, if less sensational, progress, and that even foundry practice has of late improved greatly. This improvement has been due to research work on its structure, not in the direction of new alloys. Despite some controversy in metallurgical journals as to the availability of the process for every foundry, which is claimed for it by the company exploiting it, there is no doubt that the material known as " Perlit " iron marks a substantial advance on ordinary cast iron. The process whereby it is produced is by adjusting carefully the temperature of the preheated moulds into which suitable cast iron mixtures are to be cast, to the specific purpose for which they are destined. The iron must be fairly low in silicon, but apart from this requirement, a very wide range of pig iron, within the scope of any ordinary foundry to select from its stockyard, can be employed. The special method of casting and the correct preheating of the mould result in the even distribution of the carbon throughout the ferrite, with the consequent production of a pearlitic structure of great homogeneity and strength. The uneven distribution of the graphite, inseparable from the ordinary processes of iron founding, is entirely superseded, and the micro sections of " Perlit " show how effective is the method employed, for producing castings of the fine, even, and homogeneous structure necessary when the maximum strength and toughness are required. The practical applications of the process are numerous ; Perlit castings do not develop the habit of growth on repeated heating, which is so objectionable a feature in ordinary cast iron ; their resistance to abrasive wear is far greater, and the close grain they possess enables them to resist permeation by liquids and fluids to a far greater extent than other forms of cast iron. There is no doubt that such a material is immeasurably superior to ordinary cast iron, and that its greater strength and toughness enable special parts and castings of Perlit iron to be made considerably lighter, without sacrificing, in any way, the strength required. This is not only a direct economy in material, but an indirect saving in other obvious respects. Perlit iron has been the subject of extensive research and has proved itself a most valuable material, the use of which should greatly extend in the near future.

Chromium as a Protective Coating

CHROMIUM, despite the number of years since it has been known and the vast amount of research respecting which its alloys have been the subject, is still something of a dark horse in metallurgy. Of its behaviour as a pure metal not very much is known. It is expensive and there is no very great prospect of its becoming cheaper, as its ores are not very plentiful. In this respect it ranks, indeed, with nickel, cobalt and manganese. Dr. Rosenhain, in a recent paper, pointed out that the available supplies of the more important non-ferrous metals appear to be strictly limited, and that some of them are approaching exhaustion. He excepted, in this statement, silicon, zirconium, and aluminium. Curiously enough he did not include magnesium in the short list of abundant metals. In the case of chromium the statement certainly holds good. This is to be regretted in view of some of its very valuable properties, which make it resistant to corrosion and to heat. It is an open secret that many of the new non-scaling fire-bar and boiler furnace accessories contain chromium, as an alloy with iron and other elements. While chromium, in bulk, is costly and must therefore render equally costly many of its alloys, there are methods by which some of its useful properties of withstanding oxidation at high temperatures and corrosion at ordinary temperatures may be usefully employed in industry. This is by electrolytically coating other metals with a film of chromium. Liebrich has recently described a process which it is claimed gives very good results. The current density has to be from 5 to 10 times higher than in the case of electrolytic nickel deposition. On the other hand, chromium is deposited more rapidly than nickel, and its solutions do not require the addition of potassium or ammonium salts to activate them. According to the conditions under which the operation proceeds, the chromium can be deposited either as a crystalline coating, or as a number of small spherical particles, which felt into a close grained protective coating. As the melting point of chromium is between 1,600° and 1,700°, and it is nearly as hard as corundum, its use as a coating for softer and more readily fused metals will have many applications. Steel wire coated electrolytically with chromium is said to withstand wear admirably.

Casehardening of Steel

AN interesting booklet on " The Case-hardening and Heat Treatment of Steel by Sodium Cyanide " issued by the Cassel Cyanide Co., of Glasgow, points out that, while mild or low-carbon steel cannot be hardened by heating and subsequent quenching, a product of high-carbon content, when heated to the requisite temperature and thereafter quenched in cold water, shows a large increase in hardness. A steel analysing about 0·9 to 1 per cent. carbon is more difficult to fashion for use than mild steel, and is more expensive. Modern practice, therefore, is to make machine parts or articles from mild steel and then to treat them in order to raise the carbon content of the outer skin to the region of 0·9 per cent., thus imparting to this layer the wear-resisting properties of hardened high-carbon steel. An added advantage for most purposes is that the ductility and toughness associated with mild steel are retained in the centre or core of the piece treated.

Case-hardening processes are commonly classified according to the physical state of the carburising agent. There are three chief classes, the cements in these being solid, gaseous and liquid. In the cyanide process of case-hardening and heat-treatment, sodium cyanide is employed in the molten state. Giolitti, in his standard work on the *Cementation of Steel*, writes on the subject of liquid cements : " As to the deformation of pieces, it is known to be due especially to lack of uniformity of temperature either during cementation, or more especially at the moment of quenching. But it is well known that the best way uniformly to heat a metallic piece is to heat it in a liquid bath kept at the desired temperature. It is clear, therefore, that cementation by immersion in a fused carburising bath gives the best results."

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

We are now beginning another year, and we do so in the spirit which encourages us to leave disappointment behind and look forward to brighter days. That attitude is very necessary at present. It cannot be denied that as far as the iron and steel trade is concerned the year just ended has been a disappointing one.

Review of 1925

A summary of the statistics for the year 1925 shows the position clearly. The number of blast furnaces at work through the year averages 150, compared with 185 in 1924 and 338 in 1913. Many of the old furnaces had become obsolete and inefficient and will never be restarted. The output of pig iron was more than one million tons less than in 1924, and four million tons less than in 1913, when production amounted to 10¼ million tons. If we ignore 1913 figures for the moment, it is sufficiently serious that production is so much behind the previous year. We need more work and output to lift the trade out of the despondency into which it has sunk. The figures for steel are no more encouraging. The output for 1924 was nearly 8¼ million tons, and the 1925 output almost one million tons less than that. It is true that steel production for 1925 is very little less than that of 1913, but that does not afford any consolation when it is remembered that the production capacity of the country is 50 per cent. higher than in 1913. An output of 7½ million tons in 1913 meant that the steel trade was doing well and all the works were busy; an output of just under 7½ million tons in 1925 means that the steel works are only working part time, hungry for orders and taking desperate measures to secure them. If we look at the imports and exports of iron and steel there is the same unsatisfactory picture. The imports are steadily increasing, from 2¼ million tons in 1913 to nearly 2¾ million tons in 1925, and the exports have steadily decreased from roughly 5 million tons in 1913 to about 3¾ million tons in 1925. A comparison of the price index for iron and steel with that of other commodities shows the handicap under which the trade is carrying on. In November the iron and steel price was only 18 per cent. above 1913, whereas other commodities were 53 per cent. higher; and whereas other commodities have fallen in price only 12½ per cent. below 1924, iron and steel prices are 24½ per cent. lower. The cost of steel making is about 50 per cent. higher than in 1913.

The Present Situation

Such is the position as revealed by facts and figures. One wonders what the prospects are for the future. Those who have been counting upon assistance under the Safeguarding of Industries Act have now learnt that there is to be no help from that quarter. We are not surprised at the decision. From the outset it was realised by many in the trade that the interests of the various sections were so conflicting that there was little likelihood of coming to such an agreement as would make the application sufficiently strong to win a favourable response. However, the decision has been given, and the steel trade is to go on fighting its own battle. It is advised to seek its salvation by closer co-operation and unifying of interests among the various manufacturers. We have not much faith in that direction. Already amalgamation has been resorted to rather extensively in this country, and many of the steel works which are still operating under their old-established names are members of one or other of the groups which have been formed. It may be that in some instances there has been a saving in cost and some slight increase in efficiency, but there are cases where the opposite has been the result, and on the whole the industry has not benefited greatly.

Sir Arthur Dorman, in his speech at the annual meeting of Dorman, Long and Co., expressed his opinion that amalgamation would not offer a solution of our troubles, but suggested that an arrangement with the continental makers so as to counteract the effect of the difference between conditions here and those on the continent would be of more use than any arrangement amongst ourselves. These suggestions are interesting and have weight, coming from a man of Sir Arthur Dorman's standing, but it is no use building on them, and probably the truest thing he said was that the steel trade will have to go on fighting unaided.

Future Developments

While the experience of the past year has been so unpleasant, there are certain developments which may give rise to some little hope. Germany is now realising to the full the results of her inflation policy, and with the new currency definitely established she can have little if any advantage over us in the matter of production costs. Belgium has in a sense stabilised her currency, and the costs of production there will tend to rise, although she will remain a very formidable competitor. France is the greatest obstacle to normal trading. The financial condition there reminds one of the early days of Germany's inflation, and similar difficulties are going to arise unless the steps now taken cope with the situation quickly and decisively. Whatever is done there is bound to cause an increase in the cost of production, which will check to some extent the competition from France.

In our own country it is surely beginning to be realised that there will have to be a cessation of the suicidal practice of price cutting; already there is some talk of the steel makers coming to an agreement to advance prices. If and when this is done, and done without evasion, we are convinced that there will be no decrease, but rather an increase in business. We do not advocate a large advance. It needs only a small one, sufficient to show that the market has definitely reached the bottom, to make effective the demand which we know exists. This movement has already started in fuel, and steel prices must follow suit if the industry is to survive. We must hope that the New Year will see a gradual rise in prices which will bring about a slow but sure revival in trade, which, without reaching anything like boom dimensions, will enable the steel works to carry on and achieve results to justify the payment of dividends to the shareholders.

Trade during December

There is not much to be said of the trade conditions in December. There has been practically no change from the previous month. Pig iron is still firm, with slightly better prices. The demand for export has increased more than the home demand, although the latter is better. The stocks accumulated in makers' works have been considerably reduced, but they were very heavy and there must be still a large tonnage on the ground. There is no fresh development in the steel trade, and prices are still anything but firm. All official quotations are purely nominal, and there is no hesitation in cutting prices to obtain orders. Naturally there has been a lull in business due to the Christmas holidays, but there does seem to be a slightly better tone; at any rate, an improvement is being freely talked about, but one does not care to speculate upon the outlook for the New Year. We shall have a better view of the situation when we know what is the outcome of the coal settlement. So long as that is undecided there cannot be much improvement. The Government proposals to push on with developments which will directly benefit the steel trade may be of some assistance to the industry, and every little helps.

Large Railway Contracts for 1926

It is understood that 400 new locomotives and 15,000 goods wagons are included in the improvements scheme authorised by the board of the London Midland and Scottish Railway for 1926, to cost in all about £8,000,000. Of this sum, nearly £5,000,000 has been assigned to locomotive and wagon construction, the greater part of which will be carried out by firms in different parts of the country. An order has been placed with Beyer, Peacock and Co., of Gorton, Manchester, for three "articulated" engines of the Garratt type, having a hauling power of 1,500 tons each. Some 3,000 locomotives will be reconstructed in the company's own shops at a cost of £1,750,000, and it was officially announced this week that the whole of the departments in Crewe Railway Works will now go on full time. The scheme also includes the widening of the main lines near Leeds, Crewe and Birmingham.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Antimony

A PATENT application has been made by Hüttenwerke Tempelhof A. Meyer, of Berlin, for a process for separating antimony from its alloys. The alloy is finely divided, mixed with sulphur, and melted, so that sulphides of the other metals—*e.g.*, tin, lead, and copper, are formed, and the free antimony separates out. See Patent Application No. 241,223, having the International Convention date, October 11, 1924.

Alloys

ALLOYS can be separated into their constituents by melting and allowing to cool slowly so that some of the constituents solidify first, and may be separated. The operation is effected in a furnace of such depth that cooling is sufficiently slow to enable the separation to be made. A horizontal cylindrical tilting furnace may be used. In an example, an alloy containing tin 44 per cent., lead 32 per cent., copper 4 per cent., and antimony 20 per cent., can be treated to obtain a eutectic alloy containing tin 55 per cent., lead 41·4 per cent., copper 0·1 per cent., and antimony 3·5 per cent. See Patent Application No. 241,224 (Hüttenwerke Tempelhof A. Meyer), having the International Convention date, October 11, 1924.

Recovery of Gold

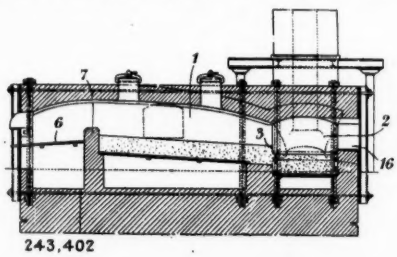
ACCORDING to an invention by R. C. Came, H. C. Booth, and The British Vacuum Cleaner and Engineering Co., Ltd., of London, the gold-bearing dust which accumulates on the face of mine stopes, walls, chutes, adits, etc., is removed and collected by a suction device, combined with means for loosening the dust prior to withdrawal. The suction device comprises independently controllable nozzles connected to a pump or fan, and carrying bristles for loosening the material. The air is passed into a cyanide vat to recover the metal. See Patent No. 242,372, dated August 19, 1924.

Alloys

ALLOYS such as bronzes can be separated into their constituents according to an invention by C. G. Bossiere of Paris, and H. Zanicoli, of Lardy, Seine-et-Oise, France, by heating them with sulphur, an alkali sulphide, polysulphide or thiosulphate, and treating the residue with water or alkali sulphide solution. The sulphides of lead and copper are not soluble, and are heated to obtain oxides, which are then converted into sulphates. Tin and antimony sulphides are precipitated from the solution by sulphurous acid, and are roasted to obtain the oxide and liberate sulphur dioxide for use again. The alkali sulphur salts are treated with carbon to obtain the sulphides. See Patent Application No. 241,880, having the International Convention date, October 23, 1924.

Metallurgical Furnaces

AN improved furnace invented by A. Breitenbach, of Siegen, Westphalia, Germany, comprises a melting chamber 1 and a



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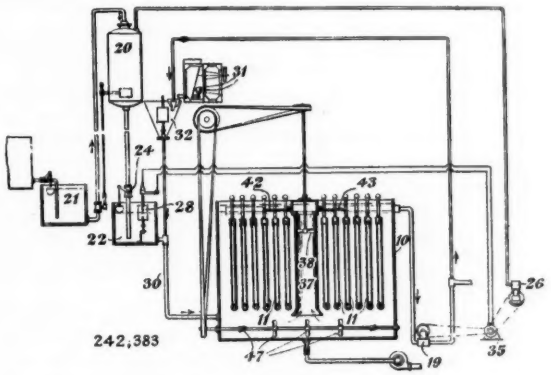
collecting chamber 2, separated by a step 3. The melting chamber is inclined slightly downwards to allow the molten metal to flow into the chamber 2. The melting chamber is heated in the usual manner by a furnace 6, from which the hot gases pass over a fire bridge 7. The immediate withdrawal of the molten metal into the chamber 2 enables it to be treated by combustion gases of any desired composition and temperature. The temperature of the molten metal may thus be high without excessive loss by oxidation. The molten metal is heated by gases from the same furnace 6, and also by oil burners projecting into the chamber 2 so as to direct the flame on to the surface of the molten metal. The slag is swept by the combustion gases from the surface of the metal into a flue at the side. Additions may be made to the metal through the openings, 16. See Patent No. 243,402, dated June 25, 1924.

Precipitating and Filtering

AN apparatus particularly suitable for precipitating and filtering gold and silver from alkaline solutions of the cyanides has been patented by L. D. Mills, and T. B. Crowe, of Palo



242,383

Alto, Santa Clara Co., Cal., U.S.A. A rectangular tank 10 has a number of filter units 11 of the vacuum leaf type having a canvas filtering medium. The solution to be treated passes from a tank 21 to a tank 20 in which a vacuum is maintained by a pump 26, and thence to a tank 22. The upper level of solution is maintained by a float-controlled valve 24, and the lower level by a float 28 which operates a switch controlling the motor 35 which drives the pumps 19, 26. The solution passes from the tank 22 through pipe 30 to the tank 10 and is supplied with a precipitant (zinc dust) from a feeder 31 which passes into a mixing cone 32. A conduit 37 is arranged vertically in the tank 10 and is provided with a rotary propeller 38 to agitate the mixture and ensure a uniform distribution. The mixture is deflected by baffles 42, 43 through the spaces between the filter units 11, and an even deposit on the filter surfaces is obtained, the final precipitation taking place in the layer of deposited solids. The heavier solid particles are prevented from settling in the tank by means of the propellers 47, and a homogeneous mixture of coarse and fine particles is obtained on the filter surfaces; it is found that the efficiency of the precipitation is thereby increased. The solids are removed from the filter units at intervals. See Patent No. 242,383, dated September 3, 1924.

Aluminium Alloys

ACCORDING to an invention by The British Aluminium Co., Ltd., G. C. Gwyer, and H. W. L. Phillips, of London, aluminium-copper alloys mainly composed of aluminium but containing substantial proportions of copper, which are too hard to be wrought, may have their physical structure modified by the addition of various modifying agents. Various modifying agents are specified, including an oxide or a hydroxide of a metal—*e.g.*, sodium hydroxide, an alkaline earth metal, *e.g.*, calcium, a fluoride, *e.g.*, sodium fluoride, and also sodamide. The effect of these additions may be illustrated by an example of an alloy containing aluminium 80 per cent. and copper 20 per cent., in which the addition of 5 per cent. of sodium fluoride to the molten metal at 950° C. increased the Brinell figure from 110·0 to 126·1. There is an optimum quantity of modifying agent which produces the best result, and this must be found by experiment for each alloy. See Patent No. 243,405, dated July 19, 1924.

Important Machinery Contract

THE Irish Free State has just appointed Hadfields, Ltd., of Sheffield, as official contractors for stone crushing plant, and it is announced that during the last seventeen months, the firm has supplied no less than 19 complete portable crushing plants to the county surveyors in that country.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The system lead-antimony. Part II. R. S. Dean, W. E. Hudson and M. F. Fogler. *J. Ind. Eng. Chem.*, December, 1925, pp. 1246–1247. An investigation of the hardening and strengthening of these alloys.

ANALYSIS.—The complete analysis of brass. Part IV. *Metal Ind.* (*Lond.*), December 25, 1925, pp. 599–601. Deals with the estimation of magnesium, manganese, copper, arsenic, sulphur and cadmium.

Estimation of silver, gold and platinum in anode sludge. E. Ecker. *Metall u. Erz*, December (1), 1925, pp. 595–598.

Analysis of materials containing a mixture of metallic iron and iron oxides. H. C. M. Ingeberg. *J. Ind. Eng. Chem.*, December, 1925, pp. 1261–1262.

CORROSION.—The rusting of iron. W. Kistiakowsky. *Z. Elektrochem.*, December, 1925, pp. 625–631 (in German).

ELECTRO-METALLURGY.—The winning of heavy metals by electrolysis of a melt. Part I. The production of iron. F. Sauerwald and G. Neuendorff. *Z. Elektrochem*, December, 1925, pp. 643–646 (in German). Demonstrates that pure iron can be obtained by the electrolysis of iron silicate.

GENERAL.—Effect of cold working on endurance and other properties of metals. D. J. McAdam. *Trans. Amer. Soc. Steel Treating*, December, 1925, pp. 782–836. This paper presents a number of graphs illustrating the effect of cold working on the strength, hardness and ductility values of various metals and alloys.

Photo-micrographs. *Metallurgist*, December 25, 1925, pp. 184–187.

IRON AND STEEL.—Electric furnace steel. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, December, 1925, pp. 748–770. A full description of the various electric processes for the manufacture of steel.

Electric steel castings. F. A. Melmouth. *Metal Ind.* (*Lond.*), December 18, 1925, pp. 584–587. A discussion of the factors affecting fluidity.

Experiments with nickel, tantalum, cobalt and molybdenum in high speed steels. H. J. French and T. G. Digges. *Trans. Amer. Soc. Steel Treating*, December, 1925, pp. 681–702. An investigation of the effect of chemical composition on lathe tool performance of high speed steels.

Thermal disturbances and recrystallisation in cold-worked steels. V. N. Krivobok. *Trans. Amer. Soc. Steel Treating*, December, 1925, pp. 703–720.

The new Wüst furnace for refining special cast iron. T. Klingenstein. *Foundry Trade J.*, December 10, 1925, pp. 487–490.

On the relation of the constitution of grey iron to its engineering properties. J. W. Bolton. *Foundry Trade J.* December 17, 1925, pp. 507–509 and December 24, 1925, pp. 537–538.

Some applications of research to modern foundry practice. J. E. Fletcher. *Engineer*, December 25, 1925, pp. 703–704. Discusses skin defects, shrinkage and contraction, and outlines future developments in cast iron.

ZINC.—Zinc compounds at high temperatures. W. G. Waring. *Mining and Met.*, December, 1925, pp. 610–613. A description of the recovery of zinc from its ores by volatilisation.

Consett Iron Industry

THE iron industry of the Consett district of Durham is the subject of an interesting booklet issued by the Consett Iron Co., Ltd. The works are approached from the River Tyne at the Derwenthaugh shipping staiths, owned by the company, a depth of 20 ft. at low water enabling steamers to be loaded up to 9,000 tons dead weight from the works. Several collieries supply the needs of the iron foundries, and the Consett Co. sells coal, coke, and coke works by-products—notably tar, from its Templetown tar works—in addition to iron and steel. The company also manufactures silica and fire-bricks, and steel slag for concreting, etc., and supplies Weardale lime at its Stanhope quarries.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered December 14, £26,100 C debentures part of £500,000; general charge. *£1,002,040. October 22, 1924.

BARROW HÆMATITE STEEL CO., LTD.—Registered December 8, mortgage to District Bank, Ltd., securing all moneys due or to become due to the Bank; charged on 1,050 railway wagons. *£844,622. May 6, 1925.

SHEEPBRIDGE COAL AND IRON CO. LTD.—Registered December 3, £8,300 debentures part of £750,000; general charge (except uncalled capital, etc.). *£500,000. October 13, 1924.

UNITED STEEL COMPANIES, LTD., Sheffield.—Registered November 26, mortgage for £3,675 and further advances to extent of 75 per cent. of value of building on land charged to U.D.C. of Harrington; charged on part of Croft Head Farm, Lowca, with buildings in course of erection. *£2,410,898 debentures and £243,998 mortgage. November 3, 1924.

WEST BROTHERS (BIRMINGHAM), LTD., metal manufacturers.—Registered November 18, £5,500 debentures; general charge.

Satisfaction

BLAENAVON CO., LTD., ironmasters.—Satisfaction registered December 11, £4,000, part of amount registered. August 24, 1911.

Metal Trades' Benevolent Society

THE sixty-fifth annual dance of the Royal Metal Trades' Pension and Benevolent Society (in aid of the Benevolent Fund) will be held at the Hotel Cecil, on Friday, January 15. Tickets, including a sit-down supper and refreshment, will be one guinea each, but members of the trade unable to attend are invited to send much needed contributions in aid of the funds to the chairman, Sydney Harvey, Esq., G. A. Harvey and Co. (London), Ltd., Woolwich Road, S.E.7. The Benevolent Fund is the source from which is dispensed temporary assistance and provision made for convalescent home treatment.

U.S. Interests in Canadian Copper

OFFICIAL announcement has been made by the High Commissioner for Canada of the sale of the Flin Flon copper mine Manitoba, for £600,000, to United States mining interests. The former owners, the Mining Corporation, retain, however, a 10 per cent. interest in the production. Development work on the property will commence immediately on a large scale. Mr. J. Hammill previously spent several years in opening up its extensive ore bodies and in 1921 a majority interest was secured by Mining Corporation, about 32 per cent. being taken by Fasken interests. Approximately £3,000,000 will be required to bring the mine into production, an important step in the development of Manitoba's latent mineral resources.

Rich Silver Vein Reported

A VERY rich discovery of ore is reported from the Creen Meehan property of the Cobalt Contact Mines in Canada. A vein running from three to six inches in width has shown values of approximately 3,000 ounces of silver per ton for the last two rounds and with the face of the drift still in ore. The work in question is in the face of a drift which was made some years ago, but which was discontinued within 10 or 15 ft., or where the ore shoot commenced to come in. These new developments lie at a depth of 165 feet.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

World Production of Iron, Steel and Coal

Strength of the British Position

By E. C. Warren, B.Com (Lond.)

World statistics of the iron and steel industries for 1924 have just been issued by the National Federation of Iron and Steel Manufacturers (price 5s. 4d.). The following analysis, specially compiled for THE CHEMICAL AGE, *shows that in export of iron and steel products during the year Great Britain led the world and that her position is improving.*

THE references which have become fashionable of late in some quarters to a declining production in our heavy industries find little support from facts just compiled by the National Federation of Iron and Steel Manufacturers. Taking the output of iron, steel and coal for various countries up till the end of 1924, the comparative statistics show clearly that despite its difficulties British production still occupies a position of world importance and is improving. This country has a greater number of blast furnaces in existence and under erection than any other. Twelve months ago the British total was 475, or 50 more than in the United States, the second leading area, and 40 in excess of the combined number of furnaces in France and Germany, these latter countries having respectively 220 and 215. In Belgium and Luxemburg, the countries of next importance, there are together not more than 100 furnaces. Moreover, apart from the United States, Great Britain had a larger average number of furnaces in blast during the year than any of her competitors. Then, in the matter of export trade, British shipments of iron and steel products, amounting to 3,850,000 tons, led the world. These were in fact equal to the combined trade of the United States and Germany, and were between 35 and 40 per cent. above the individual exports of France and Belgium.

Smallness of British Furnaces

It is in the average smallness of the size of British furnaces that our main difficulty lies. During the year under review the United States had 297 in blast throughout the first six months, and 264 during the latter half, as against 185 in this country, and as the capacity of the American open hearth furnaces was on the average more than double that of our own the output of pig iron by our competitor was far greater. Actually, for the United States this amounted to 31,400,000 tons and from British furnaces 7,300,000 tons. From this the average output per American furnace in blast may be calculated at 112,100 tons for the year, whilst similarly the British average was 39,400 tons and this was also below the figure of any of our main rivals on the continent. French furnaces in blast during the year numbered 133, and produced 7,690,000 metric tons of pig iron, making a total per furnace in long tons to compare with our own of 56,770, and the German furnaces, of which 106 were in blast, produced 7,800,000 metric tons, each giving an average of 72,360 long tons. Both these countries exceeded us, therefore, from the point of view of average and also total output. Further indication of the smallness of our furnace work is to be gathered from the returns of Belgium and Luxemburg, since the former shows an average output per furnace fully equal to that of Germany, and the latter is even above the average of French works.

Improved Position

Relatively speaking, therefore, the British output was low in 1924, but looking at the movements of recent years in the different countries the British industry shows welcome signs of expansion. Our results for 1924 were much above the average of post-war years, and were really only 3 per cent. below the average annual output for the past ten years, this being mainly due, of course, to the severe depression experienced in 1921, since when there has been a steady trend of recovery. In this we have kept fully abreast of the world-wide tendency. The United States, which has also been developing slowly in pig iron output since 1921, had a set-back in 1924, when the total was 2 per cent. below the past ten years' average. In Germany, as a consequence of inflated currency and depreciated prices, the depression was delayed until 1923, when its effects were so serious that some increased output in 1924 was a natural expectation. Nevertheless this represented a total which was much below the output of the war and post-war years generally, and when combined with the 1924 total for France, which now has the benefit of the Lorraine furnaces, the full aggregate from these areas is by no means up to pre-war standard.

One important aspect of the output is the various quantities of ore used by countries for charging furnaces, but statistics in this connection are available only in the cases of France, Belgium, and Great Britain. France required approximately 20,000,000 metric tons and Belgium 5,200,000 metric tons, and both these countries obtained practically all their ore from home supplies, whilst British furnaces using 16,900,000 tons had to import about one-third of requirements.

Higher Output of Steel

More complete comparison is possible with the totals of steel production, and the extent of the contrast in processes employed is of interest, more especially as in our own industry methods have undergone a decided change since we used the Bessemer acid process for the larger proportion of steel output. The first point to be observed from the 1924 production of British steel ingots and castings is that, contrary to statements so frequently made, our output is by no means on the decline, and the total for the latest year of 8,200,000 tons is much higher than that of pre-war years. South Wales gave the largest proportion of this output with a figure above 25 per cent., whilst the North East Coast turned out 20 per cent., Sheffield 14 per cent., and another 12½ per cent. came from Scottish rolling mills. Our total output for the year was exceeded by the United States, which produced 37,900,000 tons, and by Germany with 9,800,000 metric tons, but was above the French aggregate of 6,900,000 metric tons and the Belgian output of 2,300,000 metric tons. By far the bulk of British production originated from the open hearth process, which gave a figure of 7,500,000 tons, and of this quantity two-thirds was derived from the open hearth basic process, a method which has come more particularly into prominence during post-war years. Our former outstanding Bessemer process is showing a decline both on the basic and acid sides, with a combined total of 546,000 tons of castings or only about 6 per cent. of the whole. About one per cent. of our output, amounting to 64,500 tons, was produced from electric furnaces, and this was not only fully up to the average of the preceding years, since the method was substantially introduced in 1915, but the percentage of output was quite equal to that of other countries.

The larger total output from the United States was made up in much the same manner as British production, with Bessemer contributing 15 per cent., electric furnaces less than 1 per cent., production of some importance

from open hearth acid operations, but by far the bulk of output coming from open hearth basic methods. Analysis of the latest production in Germany shows that, judged by the methods employed in that country, it occupies a position about midway between that of Great Britain and the United States, with their predominant open hearth basic work on the one hand, and France, with Belgium, where Bessemer output represents the larger proportion, on the other. In Germany the Bessemer production was 4,016,000 metric tons, or 41 per cent. of the whole, and open hearth basic produced 5,360,000 metric tons, with a similar proportion of 54 per cent. The French position may be summed up in a one-third proportion produced by open-hearth methods, and more than 65 per cent. by Bessemer work, whilst in Belgium no less than 82 per cent. of steel came from Bessemer production.

The relative position of the different countries in respect of this steel casting and ingot output was reflected in much the same way by the various activities in output of finished steel products. Taken together, the full output of these five countries amounted during 1924 to 48,000,000 tons and of this the United States quota was 58 per cent., followed by Germany and Great Britain, with 15 per cent. and 14 per cent. respectively; whilst France produced 9 per cent. and Belgium about 4 per cent.

Finally, the coal and coke production during recent years discloses that, having regard to other countries, the British position has been well sustained. The output of coal, for example, in the U.S.A. was calculated at 573,000,000 tons during 1924, and this was below the average annual production of post-war years. In France the combined total of coal and lignite was shown at 58,000,000 metric tons, and the increase which this represents over preceding periods by no means counterbalances the decline in German coal production. During the year this latter country reported an output of 118,800,000 metric tons, or about 70,000,000 metric tons less than pre-war. Changed economic conditions in Germany have, however, given a remarkable impetus to lignite production, the latest figure, which is in excess of 124,000,000 metric tons, revealing a 50 per cent. expansion over pre-war volumes. Belgian coal production indicates a greater steadiness year by year than elsewhere, and the 1924 total stood at 23,360,000 metric tons. As against all these results the British total for 1924 of 267,000,000 tons was quite prominent, and, moreover, as compared with previous British totals stands out with that for 1923 as our best annual production since the year 1913. On this latter basis of comparison our coke position is also sound. In 1913 the total coke output for Great Britain was 20,600,000 tons, for the year 1920 it became 20,900,000 tons, and for 1924, including a quantity of breeze, it totalled 24,800,000 tons.

Manganese, its Alloys and Uses

By G. Malcolm Dyson, Ph.D., A.I.C.

ALTHOUGH metallic manganese does not find any extensive industrial application *per se*, its alloys are among those which have become indispensable in various electrical and metallurgical engineering operations; while compounds of manganese are extensively used in both fine and heavy chemical industries.

The ores of manganese, which are comparatively widely distributed in nature, are valuable according as their available oxygen content is high, and their utilisation a matter of comparative ease. In the case of the various sedimentary deposits of manganese ore known as "wad," the presence of organic matter, etc., together with a high percentage of moisture renders their utilisation impossible, and in practice they are neglected in favour of more practicable minerals. It is of interest to note, in passing, that these deposits of "wad" are due to the solubility of manganese carbonate in solutions of carbon dioxide, a solution of manganese bicarbonate being obtained, which, by aerial oxidation and contact with organic matter, gives a precipitate of manganese dioxide.

Much manganese ore is used directly without purification—in fact "manganese" is the commercial synonym for crushed pyrolusite, and while for the preparation of manganese and its alloys any comparatively pure ore of manganese will serve, the ore used directly for the manufacture of dry batteries, etc., depends for its value on the available oxygen it contains. The following is a list of the principal ores:—

Ore.	Formula.	MnO_2 Per cent.	Available O_2. Per cent.
Pyrolusite	MnO_2	up to 100	18·4
Psilomelane	$(MnBa)O.MnO_2$	42–77	7·3–13
Manganite	$Mn_2O_3H_2O$	48–50	9
Braunite	Mn_2O_3	42–44	8
Hausmannite	Mn_3O_4	38	7
Rhodochrosite .. .. (Manganese Spar)	$MnCO_3$	0	0

Certain manganese ores contain an appreciable amount of silver, and for this reason are used as fluxes in lead smelting operations, whereby the silver passes into the lead and can be recovered in the usual way—concentration and cupellation. Manganese ore for the manufacture of standard ferromanganese should not contain less than 35 per cent. of manganese, or more than 8 per cent. of silica, while the phosphorus content should be low. For glass colouring, the amount of iron should not exceed ·1 per cent. The ore for battery work is bought on the unit system, *i.e.*, in pence per unit per ton. Fluctuations in the price of manganese ore for the last thirty years are shown in the accompanying curve (Fig. 1).

Undoubtedly the best method for the preparation of pure manganese is the electrolysis of the chloride in saturated aqueous solution. The pure metal is deposited on the cathode in a coherent mass, which, when polished, has a faint pink tinge. Commercial manganese metal is prepared by the aluminothermic reduction of the oxide Mn_3O_4 by the Goldschmidt process. Metal so prepared contains an appreciable amount of aluminium, and up to 5 per cent. of silicon, presumably derived from the crucible in which the reduction is carried out. Pure manganese is a comparatively soft metal, which can be readily polished, and which is rapidly corroded by water and moist air. Manganese containing a few per cent. of either silicon or iron is hard and unalterable in air. Manganese, either in its pure or impure forms is readily attacked by dilute acids.

Standard Ferromanganese Alloys

Far and away the most important alloy of manganese is that with iron and carbon; in fact, well over 90 per cent. of commercial manganese is used in the treatment of iron and steel. The addition of a small amount of manganese (0·5—0·8 per cent.)—not enough to warrant the term "alloy" or "manganese steel"—renders the ingots clean, sound and comparatively free from blowholes. In addition, the steel is easier to work and tougher in use. Formerly, there were two standard alloys that were used for the preparation of manganese steels, ferromanganese, containing 78–80 per cent. Mn, and spiegeleisen, containing 18–20 per cent. Mn.

At present there are four recognised standard alloys:—

	Mn.	Fe. (Percentages).	Si.	C.
Ferromanganese ..	50–80	10–42·5	2	5–7
Spiegeleisen	10–35	60–85	1	4–5
Silico-manganese ..	55–70	5–20	25	0·35
Silico-spiegel ..	20–50	33–74	4–10	1·5–3·5

In addition, specifications for such alloys generally insist that the percentage of phosphorus shall not exceed that required to give a maximum of 0·05 per cent. in the finished steel.

The various manganese-iron-carbon-silicon alloys are obtained by some modification of blast-furnace practice. Manganese ores are added to the burden of the furnace, and the ferromanganese is tapped off in place of the iron. The amount of coke charged in running for ferromanganese is higher than normal, the top temperature rises, and while the amount of carbon monoxide in the exit gases rises to about 50 per cent., the tuyere pressure falls to 3–8 lb. per sq. in. Ferromanganese usually operates with a slightly colder hearth than iron, and gives a slightly colder metal and slag. Results of gas analyses at various positions and stages in the furnace show that the manganese is reduced directly by carbon, and that the reaction in all probability takes place on the hearth. The amount of manganese recovered as alloy is comparatively

high ; operating for a 70–80 per cent. ferromanganese, about 70–75 per cent. of the manganese is recovered. The rest of the manganese goes to the slag or is lost as flue dust. The main sources of loss in operating for ferromanganese are :— (1) Volatilisation by running the furnace too hot. (2) Loss of manganese in slag owing to an increased basicity. (3) Loss in slag by charging a deficiency of coke. The last factor—the amount of coke charged—is very important since it has a considerable effect on the amount of manganese wasted in the slag. The general effect of charging positive and negative coke differences on the percentage of manganese in the alloy is shown by the curve in Fig. 2.

For high manganese alloys it is possible to use a modified process on manganiferous iron ore, operating in two stages.

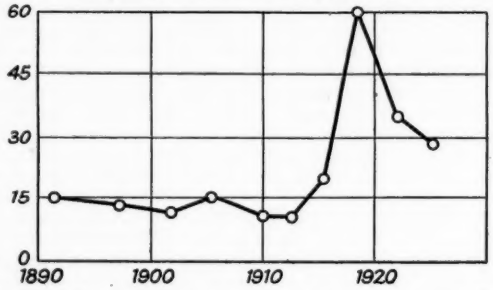


FIG. 1.—FLUCTUATIONS IN PRICE OF MANGANESE ORE.

The first step consists of a low temperature reduction in which the bulk of the iron is reduced to the metal while the manganese is retained in the slag. The slag and iron can be tapped together into conical moulds and the iron separated as a button, or preferably the iron and slag are cast into blocks, crushed, and run through a magnetic separator. The crushed slag is then smelted at a high temperature with carbon and a high percentage ferromanganese obtained.

Electric Smelting

Electric smelting is also suitable for the preparation of high percentage ferromanganese. A rectangular bath furnace with carbon or magnesite lining is used, and a manganese ore containing 39–44 per cent. of manganese and 15–25 per cent of silica is used. The furnace is operated continuously in a manner similar to that with the aluminium furnace save that the metal and slag are tapped together into a settler. The furnace is fluxed with limestone, and an occasional addition of a small quantity of fluorspar. Steel scrap is added from time to time during the running, to furnish sufficient iron for the production of the desired alloy. Some idea of the efficiency of the process can be obtained from the fact that, using the ore just described, 5,000 k.w. hrs. are required together with 170 lb. of carbon anodes for the production of one long ton of 80 per cent. ferromanganese ; 75 per cent. of the manganese is recovered as alloy, but the cost does not compare very well with that of the blast furnace process, unless the cost of electrical power is phenomenally small.

Manganese steel containing 10–15 per cent. of manganese, as first introduced by Hadfield, has a number of properties that single it out from other varieties of alloy steels. It has a high fluidity and will fill intricate moulds, and gives castings which are practically free from blow-holes ; while heat treatment produces in it an almost opposite effect to that obtained with the majority of steels. Quenching makes it tough, ductile and non-magnetic, while annealing renders it brittle, hard and magnetic. To secure the maximum toughness and ductility the steel is quenched from a temperature of 1100° C. Quenched manganese steel appears to have a purely austenitic structure. The toughness of the manganese steel makes it of great use in the manufacture of armour plates and shrapnel helmets, being only dented, where ordinary steel would have been shattered or pierced. Manganese steel is extremely resistant to abrasion and for this reason finds extensive use in the manufacture of crusher and breaker jaws, tramway rails, railway crossings, rolling-mill rolls, etc. The hardness of the steel increases with the deformation, so that the use of manganese steel crusher jaws on refractory material actually improves them ; for this reason, also, it will be seen that manganese steel cannot be worked at the lathe with ordinary tools, but must be cast and ground to shape.

Manganese bronze is obtained by adding sufficient 25 per cent. cupro-manganese to molten bronze to bring the manganese content to about 1–3 per cent. ; it is malleable, tough, and resistant to sea water corrosion, and is, for this reason, used for the construction of propeller blades. Another variety of manganese bronze contains no tin or zinc, but consists of copper with about 5 per cent. of manganese. "Manganin," an electrical resistance wire, and manganese silver, which is similar to German silver in properties and appearance, have the following compositions :—

	Mn.	Cu.	Ni.	Zn.
Manganin	12	84	4	—
Manganese Silver	2	58–60	—	38–40

The presence of 1 per cent. of manganese in an alloy containing 95·5 per cent. of aluminium, 3 of copper and ½ of magnesium confers strength and toughness on the alloy, without decreasing its lightness, thus rendering the alloy eminently suited for aeroplane and automobile construction.

Uses of Manganese Compounds

The use of manganese compounds may be summarised under the following heads :—(1) The use of MnO_2 as a battery depolariser ; (2) decolourisation of glass ; (3) paint driers ; (4) permanganates ; (5) colouring bricks, tiles and glass ; (6) calico-printing and dyeing.

The dioxide MnO_2 does not find so extensive a use for the manufacture of chlorine as formerly, the process being supplanted by the use of electrolytic cells ; but manganese dioxide still occupies the principal place as a "deoxidiser" in dry batteries. The dioxide is incorporated in the "mix," which is the vital part of the cell, and absorbs the hydrogen formed according to the equation :—

$$2H + 2MnO_2 = H_2O + Mn_2O_3.$$

Caucasian pyrolusite was formerly regarded as the purest and best form of the mineral for battery use, but there have been many equally satisfactory deposits developed elsewhere during the last ten years. Pyrolusite for batteries should be free from traces of iron and copper, which exert a very deleterious effect. The ore should be crushed to 10–20 mesh. A large number of processes have been devised and patented for working up inferior manganese deposits. Pyrolusite usually occurs as a hard ore lying on a limestone bed. The dry methods of purification consist of careful selective dressing, followed by jigging, screening and water classification, with magnetic separation for the removal of iron. The ore is then calcined to remove free and combined water, and carbon dioxide. For obtaining a pure manganese ore for reduction and chemical purposes, a chemical method of extraction has

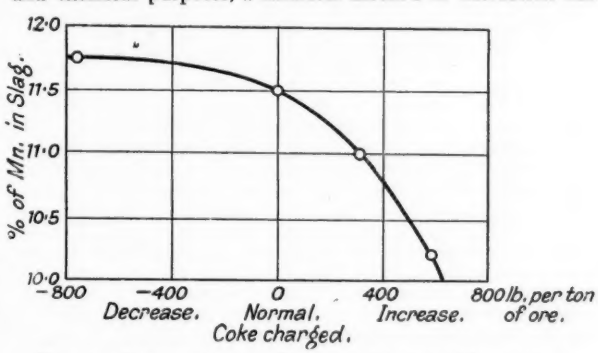


FIG. 2.—INFLUENCE OF COKE ON LOSS OF MANGANESE.

been devised. The ground ore is suspended in water and the hot gases from a pyrites burner forced in. The manganese goes into solution at 40–60° C. The filtered solution is evaporated and the residue calcined at 800–1000° C., when a hard compact clinker containing 60–64 per cent. of manganese is obtained.

The use of manganese in glass manufacture, as a corrective to the green colour caused by traces of iron in the raw material dates from very early times. Whether the action is due to physical causes—the green of the iron tint being complementary to the violet of the manganese—or to the chemical oxidation of green ferrous silicate to colourless ferric silicate is unknown ; 3 per cent. of manganese gives a black glass, and

(*Concluded in col. 2, page 15*)

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Iron and Steel Statistics

THE position of the iron and steel industries revealed by our special analysis of the latest statistics, which appears on another page, is much more hopeful than was generally imagined before the figures became available. Not only in this country are there a larger number of blast furnaces in existence, but more were actually in operation than elsewhere, except in the United States. While relatively speaking the British output of pig iron in 1924 was low, the industry shows welcome signs of expansion, when the movements of recent years in the different countries are taken into account. The case of steel products is similar, and despite pessimism which was recently so prevalent, British production of steel ingots and castings in 1924 was much higher than that of pre-war years. This improved state of affairs is largely due to the use of the open hearth basic process, by which the larger proportion of our steel output is now produced. Further, in the matter of export trade, Britain led the world with its shipments amounting to nearly 4 million tons, which was, in fact, equal to the combined trade of the United States and Germany.

These facts emphasise the necessity of taking every factor into account when considering trade returns, and show how necessary it is to consider the position of this country in relation to the trade of the world as a whole. While isolated figures appear to show an unsatisfactory state of affairs, the latest world statistics afford considerable encouragement, and it is to be hoped that when the complete returns for the past year become available, a better position will be revealed. The firmer prices of pig iron which have lately prevailed afford hopes that the iron and steel industries may look forward to improved trade during the present year.

Indian Mineral Output

ACCORDING to a report of the Geological Survey of India now in hand, our Bombay correspondent writes, the Indian mineral industry showed increased activity during 1924, which was specially marked in the case of coal and iron. The output of coal reached the record figure of 21·2 million tons, an increase of 1½ million tons over the previous year, while the output of iron ore increased from 821,000 tons to 1,445,000 tons, *i.e.*, by 76 per cent. The total output of pig-iron rose from 599,000 tons in 1923 to 872,000 tons in 1924, a large part of which was exported. The Tata Iron and Steel Co., like other ironworks, showed greatly increased activity. It is worthy of note that ferro-manganese rose from 3,500 tons to 8,950 tons, similar progress being recorded in the output of manganese ore, which increased from 695,000 tons to 803,000 tons. Though most of the manganese ore is exported, there is evidence of increased internal consumption at the works of the iron companies. The Bawdwin mines in Burma, belonging to the Burma Corporation, Ltd., are now producing greater quantities of lead and silver, which amounted in 1924 to 50,500 tons and 5·3 million oz. respectively. Tin is mined wholly in the Tavoy and Mergui districts of Burma, and during the year the production amounted to 1,963 tons, a slight decrease compared with the previous year. The output of wolfram also decreased from 872 tons to 739 tons. Gold, which showed steady decline since 1919, has slightly recovered, its production amounting to 396,000 oz. as against 383,000 oz. in the previous year.

The Chemistry of Steel Making

THE latest issue of the reprinted papers of the Faraday Society* relates to a meeting held jointly with the Iron and Steel Institute. The subject discussed was the physical chemistry of steel making processes, and nine papers were read in a session of four hours. The time was too short or the papers too many, but their interest more than justifies their existence and the symposium now published constitutes a useful record of a useful occasion.

Sir Robert Hadfield presided over the meeting and contributed in his opening paper, a characteristically thoughtful and wide-eyed survey of the general question. Of the other papers, two stand out from the rest as worthy of special mention. One was by Dr. McCance, on "Balanced Reactions in Steel Manufacture," and the other, by Mr. T. P. Colclough, discussed the "Reactions of the Basic Open Hearth Furnace." Dr. McCance's paper dealt largely with the iron-oxygen reactions and the influence and effect of the other elements present in molten steel upon them. Some very valuable tables relating to the deoxidation of liquid steel are given, and although, at the time his paper was being written, Dr. McCance was not aware of the results obtained by Rosenhain and Hanson, on the vexed question of the solution of FeO in steel, his own results are of much the same order as those of the National Physical Laboratory investigators. Dr. McCance's figures were admittedly based largely on theoretical considerations, as Mr. Service pointed out during the discussion, and although deoxidation must play a very important part so far as the ultimate soundness of steel is concerned, the author likewise admitted in his reply that many other considerations enter into that abstruse and difficult problem.

As a matter of fact, a sub-committee of the Iron and Steel Institute, under the able chairmanship of Dr. W. H. Hatfield, have the whole question of blowhole distribution and segregation in steel ingots under consideration, and it is hoped that a report will be forthcoming before long, possibly at the meeting of that Institute in May next. Such investigations are very intimately connected with the physical chemistry of steel making processes, and if, as Dr. Hatfield foreshadowed in the discussion on Dr. McCance's paper, the makers have "put all their cards on the table" for the committee's consideration, it may be hoped that its labours will go far towards the elucidation of the many factors which render steel ingots heterogeneous. It was once said by a leading steel maker that the only way of obtaining a really sound ingot was to cut it in two, and throw both halves away! Perhaps, now that rather more is known about the solubility of FeO in liquid iron, and the probable rationale of the deoxidising materials present or added, some cheaper method and some less heavy "discard" will be found compatible with the production of really sound and homogeneous ingots.

Improving Symposium Meetings

THE Faraday Society was one of the first to institute conjoint meetings with kindred societies at which papers bearing on some broad and general topic of mutual interest could be read and discussed. Such meetings have a far greater value than many of the *omnium gatherum* occasions when a large number of papers on a diversity of subjects are put on the programme, and the interest is more diffuse, and the audience united by no common bond of purpose. The "general discussions" of the Faraday Society have ranged over a wide variety of subjects, from the physical chemistry of photographic processes, to the occ'usion of gases in metals; and from catalysis to X-ray work. The value of the collected papers dealing with such concrete and well defined topics, when republished together with the discussions and correspondence to which they have given rise, may be gauged by the fact that many of them are out of print, and their prices comparable, on the rare occasions when they are encountered in secondhand bookshops, with the *incunabulae* of the buyer of "old editions."

One criticism may be made of the latest issue of the reprinted papers, directed not against this particular meeting so much as against similar symposia in general. It is that in order to avoid overlapping and at the same time the omission of important aspects of a subject, the committees which undertake the arrangement of such meetings should go a step farther and draft a brief programme of the specific aspects of whatever subject they propose to deal with, and what particularly it is desired to elicit. The details of such a synopsis of objects should then be circulated to each person who is invited to contribute a paper, so that there should be some definite co-ordination as to plan, and so that each contributor should confine himself to the aspects and limitations consonant with that plan. The resulting symposium would be thus more complete, coherent, and informative.

* THE PHYSICAL CHEMISTRY OF STEEL MAKING PROCESSES. London; The Faraday Society. Pp. 128. 8s. 6d.

Chromium Plated Steel

THE inordinately heavy toll exacted by corrosion on all metals in common use, more especially on iron and steel, affords ample justification for reverting to the subject of chromium plating, to which attention was directed last month in these columns. The importance of the question in industry is borne out by the increasing space now being devoted to it in the Continental and American technical Press. Comparative tests have shown conclusively that alike under the influence of atmospheric corrosion, the action of steam, and exposure to the most severe, perhaps, of all such agencies, salt water spray, " chrome plate " behaves far better than platings of other metals. It is found, however, that the chromium plating must not be less than a certain thickness, as thin coatings are apt to prove porous and so become susceptible to corrosion. To save expense, an intermediate metal may be employed to bind the steel and the chromium together and both nickel and cadmium have been used for this purpose. It has been found in practice that nickel is more satisfactory ; with cadmium as the underlie there is a tendency to stripping, and chromium plated over cadmium will not give the high degree of polish found possible when nickel is used as a preliminary coating. The polish is in itself protective, as it is well known that surface roughness affords *loci* for the commencement of the processes of corrosive deterioration.

Apart from this consideration there are serious difficulties in chromium plating technique which can only be overcome by experience, and may entail expensive failures until that experience has been gained. The temperature of the electrolyte has to be kept fairly low. A solution of 30 per cent. chromic acid and one per cent. sulphate is recommended by one authority, with a current density of 0·8 to 1 ampere per square in. The bath is, in this case, cooled with water. There is some conflict of evidence as to whether carbon will diffuse through chromium, but most authorities agree that it does not. A chromium plated part cannot therefore be case hardened or cemented. One of the most useful applications of chromium plating is for the plates of bank and other engraved notes which have to withstand continuous abrasive wear during printing. Such chromium plated surfaces are said to be in use in America, and the hardness is far superior to anything previously attained.

Need for Foundry Specialists

AN important plea for intensive training in foundry work was put forward recently by Sir William Ellis, speaking at the fourth annual meeting of the British Cast Iron Research Association. It had to be candidly admitted, he said, that as much relative progress had not been made in the physical properties of iron castings as had been made in various directions in connection with steel. This, however, was not the fault of those engaged in the cast iron industry, but because of " a kind of accepted principle amongst engineers that cast iron will do certain things, and no more." Coming from so eminent an engineering authority as the President of the Institution of Civil Engineers, this opinion is of particular interest. Engineering has now become such a wide science, Sir William went on to say, that it was impossible to be really strong on more than two or three subjects, and he suggested that a similar feeling was needed that foundry work is one section and that smith work or forging work is another.

Instead of young engineers taking a general course of apprenticeship in the pattern shop, drawing office, foundry, etc., some of them should specialise in foundry work and bring the wide knowledge of engineering training to bear on its application. The difficulties at present of obtaining a manager with a wide knowledge as a specialist in foundry practice are ten times greater than that of finding a man with general knowledge of fitting, tool making and so on. As an instance of what can be done by the scientific application of work to the industry, Sir William mentioned the centrifugal casting of pipes. This country is right ahead of all other countries in this particular field as a result of research.

Industrial Support of Research

IT is remarkable, however, as Mr. A. L. Hetherington, of the Department of Scientific and Industrial Research, pointed out on the same occasion, that the Research Association is not more widely supported by the industry. Something less than 25 per cent. only of the firms which might be expected to be members are subscribers to-day, whereas if the Association were to be more fully representative and to have the necessary funds at its command there is little doubt that it would potentially be a very great thing for the industry. The Information Bureau, for instance, which is one of the important features of the organisation, enables members to be kept informed of what is being done here and elsewhere, although it is not sufficient merely to be kept up-to-date. It is necessary to be active participants in new progress and in breaking new ground, and, just as in the United States, there must be more readiness to share information.

In the words of Dr. Rosenhain, of the National Physical Laboratory, the cost of maintenance and development of the Research Association is literally trifling compared with the other costs of industry, and the support should be on a much larger scale than is actually the case.

Falkirk Foundry Technical Institute

THE arrangement just completed whereby the Cast Iron Research Association and the Falkirk Foundry Technical Institute have agreed to amalgamate their interests, gives the Association possession of laboratories in Scotland, which should result in further accessions to membership among Scottish founders. The Falkirk Foundry Technical Institute was founded in 1917 for the purpose of carrying out experimental work on behalf of a number of founders in the Falkirk area, Falkirk being the only town in Great Britain where ironfounding is the staple industry. As a result of the amalgamation, members of the Institute become ordinary full members of the Cast Iron Research Association, and existing and future Scottish members of the Association will receive all the advantages of the Institute.

Inter-University Conference

AN important gathering of metallurgical students, representative of the whole body of university-trained metallurgists in the United Kingdom, will take place in the Edgbaston buildings of Birmingham University on February 19 and 20. The object of the conference is the promotion of a fuller understanding and co-operation between works and university departments, and for this purpose the subject for discussion will be " The Position of the Metallurgical Student in Industry." Representatives of local and other works are invited to attend, and correspondence from heads and works managers on the subject will be welcomed. Delegates will pay a visit to the British Industries Fair and will be entertained at a dinner on February 19 by the Birmingham University Metallurgical Society. Further information can be obtained from the honorary secretary of the Society.

New American Research Station

The new metallurgical laboratories of the Pittsburgh Experiment Station of the U.S. Bureau of Mines were formally opened on January 26. These are the outgrowth of an agreement made in 1923, under which the Carnegie Institute of Technology appointed an advisory board for its department of metallurgy, and arranged for co-operative research fellowships in metallurgy at the Pittsburgh station. Certain problems in iron and steel formerly conducted by the Bureau at Seattle will now be studied at Pittsburgh, and these include the melting of sponge iron ; reduction and carburization in iron smelting ; mill ball compositions and preparations ; abnormality in case carburized steels ; non-metallic inclusions of steel ; and requirements for open-hearth refractories.

The large technical staff of the Bureau will be assisted by members of the faculty of the Carnegie Institute and its advisory board, which is composed of prominent metallurgists connected with the industrial organisations of Pittsburgh. Some of the investigations will be conducted largely in operating plants in the district. Four fellowships are supported by the Institute, and the equipment of the new metallurgical section includes a modern electric-furnace laboratory as well as metallographic and chemical laboratories. The Pittsburgh section is under the general supervision of Mr. D. A. Lyon, assistant director and chief metallurgist of the Bureau of Mines, and is one of the three sections working on ferrous metallurgy, the other two being at Birmingham and Minneapolis, where the beneficiation of low-grade iron ores and the principles of ore reduction are being studied.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

To use an old war time expression, there has been a certain liveliness in the steel trade during the month of January which encourages the belief that we may be on the eve of an advance from the unsatisfactory position into which the trade has been forced gradually during the past few years. There is all round a more hopeful frame of mind, and private as well as public utterances give promise of a forward movement which will be as welcome as it is necessary. In their recent public speeches, the heads of the great banks, who are certainly entitled to be heard on this matter, have been unanimous in their predictions of better trade and a more hopeful outlook. At the same time it is not possible to give definite evidence of the commencement of a trade revival so far as the iron and steel industry is concerned, and the matter is being regarded in something of a cautious spirit.

New Year Optimism

Once again the old optimistic feeling of the beginning of the year is abroad, but on this occasion there is no hurry to take it too literally, and there is more of a "wait and see" attitude manifested. It is the right attitude to adopt, for while generally speaking there seems to be more work about, the improvement in that respect is not constant. Most of the works are having the same experience, a week or two of good orders followed by a comparative lull, and this fact prevents any undue jubilation as to the prospects. If there were nothing else, the uncertainty of the position in the coal trade is sufficient to have a restraining influence on trade activity, and on all hands one hears the opinion expressed that there will be no good done until that question is settled; and much will depend on the lines of the settlement.

It is not surprising, therefore, that there is no attempt to force the movement. The prices of finished materials have not moved upwards, and makers are willing to book contracts well ahead at the present low rates. There is no holding off in the expectation of better prices later on in the year. The last two years' experience no doubt accounts for that. There was at the beginning of each of the past two years a strong feeling that we had definitely reached the bottom, and many contracts were made at the then ruling prices in the firm belief that they would turn out to be advantageous. They did so, but not to the buyer, and makers now would be much happier if they could go on selling at those prices. Nevertheless one feels safe in saying that the level of prices which we have now reached is so low as to preclude any possibility of further reductions, excepting such as any one works is willing to make in order to secure a particularly attractive order, and there is no doubt that this belief is causing many buyers once again to take the risk of booking contracts. We venture to prophesy that in this instance the risk is on the part of the seller. The upward movement has already started in some of the principal raw materials. Coal and coke are decidedly dearer than they were three months ago, scrap is costing more and will go still higher as soon as there is any increased demand consequent upon a greater volume of business in the steel trade. Pig iron has followed suit and considerable advances have been obtained by the makers. On the other hand, prices of finished material have fallen during this period of rising prices in raw materials, so that makers have been forced to acquiesce in an increase in their cost of manufacture on the one side and a decrease in the returns from their sales on the other.

Rock Bottom Steel Prices

It is this fact, we think, which justifies the opinion that steel prices cannot be further reduced. If we are wrong in that, then we are afraid that the already higher prices of fuel and raw materials will prevent any improvement in trade for the present. Moreover, the claims of the lower paid men in the industry are again being heard. The men in the various engineering unions are asking for a considerable advance in wages, and many of the other classes of workers are only waiting for a favourable opportunity to put in their demands. Higher costs in materials and wages and lower selling prices are not going to help the steel companies to recover their financial stability. Lower costs are needed; and among the means of obtaining them are greater output and improved methods of manufacture. Greater output results not only from a larger volume of orders, but from a better spirit of co-operation on the part of the men and their leaders, and to a great measure these two depend on each other. It is the desire for a greater volume of orders that has led to so much price cutting, although it is doubtful whether the results achieved have justified the extent of the cutting. Unfortunately, as we have previously pointed out, the matter has been complicated by the greater capacity of the British steel plants as compared with pre-war days. In many instances the greater output has no chance to effect a reduction in costs as it is needed to find some work for the additional units of plant.

The other method of reducing costs, by installing the latest plant and machinery for effecting economies is outside the reach, for the moment, of most of the large steel firms. There is a lot that can be done on this line. It means a considerable outlay in money, but the resultant saving in the cost of manufacture shows a good return on the expenditure; and the reduction in costs means more orders.

Improvement in Pig Iron

As we have already stated, the pig iron section of the trade is most favourably situated at present. In this market there is no question about the actual improvement. There has been a better demand and prices have again advanced as compared with last month, basic iron and foundry iron being the qualities favoured; forge iron is still very little in demand. Many of the makers of foundry iron have sold their output well ahead, and generally there is no inclination to shade prices; indeed a further advance would not be surprising, although the possible opening that might give to continental pig iron is not to be overlooked. With the small number of blast furnaces at work, less than one-third of the total number built, it is natural that the pig iron market should quickly respond to a favourable tendency, and when we do get to really brisk trade in steel it is probable that we shall be faced with a shortage of pig iron. Many of the furnaces now built will never work again, and it may not be too sanguine to look forward to a time not too far distant, when it will be a paying proposition to build new up-to-date furnaces to cope with the demand for home consumption and for export.

Big Railway Orders

The steel trade has once again been helped by the orders which the railway companies have put out. The London Midland and Scottish programme is an extensive one. Many of the locomotive builders are already benefiting from it, and the orders received from these as well as from the railway company direct are very useful to the steel makers. There is also a lot of work for the steel trade in the foreign railway orders that have been placed in this country. Most of the carriage and wagon builders are very busy indeed, and as a large proportion of the foreign orders are for steel carriages the steel trade is getting some benefit out of them. Among the good orders that have recently been placed is one for 33,000 tons of rails for the London and North Eastern Railway. This has been divided amongst nine of the steel makers. The Leeds Forge Co. have secured an order for thirty Pullman cars for the International Sleeping Car Co., Ltd., and this will mean extra work for the steel makers. In addition this company has an order from the High Commissioner for South Africa for five hundred all steel bogie covered wagons of forty tons capacity, and seventy all steel bogie hopper coal wagons.

Prices of steel all round are, if anything, firmer. Sections have recovered from the £6 17s. 6d. figure to which they had fallen, and £7 2s. 6d. appears to be the general prices, although there are instances of £7 being taken. Plates are about £7 17s. 6d., although here also a reduction of 2s. 6d. per ton can be obtained for a good order. The production figures for December are better when one takes into account the Christmas stoppage. Pig iron was 503,400 tons compared with 494,100 tons in November. There were the same number of furnaces in blast as in November. Steel production was 606,800 tons compared with 653,800 tons in November.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Nickel-Copper Alloys

NICKEL-COPPER alloys have been made by smelting the ore containing nickel and copper sulphides and calcining the matte in a roasting furnace until the sulphur is reduced to about 1 per cent. Soda ash is then added as a flux, and the mixture leached with water to remove the soda and reduce the sulphur to about 0·1 per cent. The oxide is dried and screened, mixed with 7 per cent. of soda ash and again calcined and leached to obtain an oxide containing not more than 0·01 per cent. of sulphur and about 10 per cent. of moisture. This oxide is mixed with charcoal and charged into an acid open hearth furnace heated by oil having a low sulphur content, since sulphur cannot be eliminated in this operation.

An improvement which reduces the number of steps has now been patented by the International Nickel Co., of New York. The ground bessemerised matte obtained from the nickel-copper ore is treated in a mechanical roasting furnace without any flux until the sulphur content is reduced to about 0·25 per cent. The hot calcined oxide is discharged into crane buckets into which ground charcoal is simultaneously fed. The heat of the oxide effects the reduction of about 90 per cent. of the oxide, and the material is then fed into a basic lined electric furnace of the Heroult type. The material is smelted and refined, and the sulphur is reduced to less than 0·01 per cent. The metallic alloy is tapped out and cast in the usual manner. See Patent No. 243,892, dated November 21, 1924.

Heavy Metal Carbides

A PATENT application has been made by Gewerkschaft Wallram, of Essen, Germany, for a process and apparatus for producing tungsten and other heavy carbides. The material to be fused is placed in a cavity 28 in a carbon rod 27 within a carbon tube 18 forming a heating element of an electric furnace. The rod 27 with the molten substance is removed from the furnace for casting. The tube 18 is mounted between carbon blocks 19 in an iron container 22 containing carbon granules which may be discharged into a container 25 when the carbon 18 is to be replaced. A crucible for larger castings may have a channel 34 leading to the funnel 36 of a mould 37. The charge may be metallic tungsten and carbon or tungstic acid anhydride or oxide or one of the two tungsten carbides. The carbon may be absorbed from the crucible. The process is also applicable for treating powdered molybdenum, titanium, uranium, chromium, vanadium, silicon, and boron. See Patent application No. 242,951, having the International Convention date, November 14, 1924.

FIG. 1

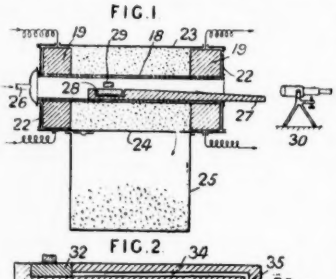
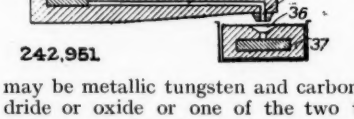


FIG. 2



242,951

Electrolytic Aluminium

ACCORDING to a process by T. R. Haglund, of Stockholm, a molten electrolyte composed of crystalline aluminium oxide of high specific gravity such as that formed by crystallisation from corundum and amorphous aluminium of low specific gravity obtained by calcination of the hydrate or salts of aluminium is electrolysed to obtain aluminium. The amorphous oxide is in the proportion of 10–40 per cent. See Patent application No. 242,958 having the International Convention date, November 5, 1924.

Reducing Ores

IN the process by H. G. Flodin, of Näsby, Roslags, Sweden, and E. G. T. Gustafsson, of Stockholm, for reducing iron and other alloys a charge of ore briquettes low in carbon and another charge rich in carbon are treated together in an electric furnace. The charge richer in carbon may be entirely carbon such as charcoal, peat, coke or anthracite, and may be fed into the furnace and round the electrodes on to the slag formed in the reduction of the charge. The metal may be deoxidised and recarbonised before tapping by adding finely divided oxide of manganese and finely divided carbon. See Patent application No. 243,353, having the International Convention date, November 19, 1924.

Concentrating Ore

A NEW oil for use in flotation processes is being patented by Barrett Co., of New York. These are tar oils and sulphidised tar acids which are obtained by treating oil containing tar acids with disulphur dichloride, by similarly treating tar acids and then mixing with tar oils. Creosote or creosote oils containing phenols or cresols may thus be treated with disulphur dichloride and used in flotation processes. See Patent application No. 243,383, having the International Convention date, November 22, 1924.

Direct Production of Iron and Steel

A PROCESS has been patented by R. H. M. L. Tournié, of Paris, for the direct production of iron and steel without preliminary casting, from washed or unwashed iron ores including those which cannot be separated from their gangue. The ore and flux, with or without carbonaceous substances, are placed in a tilting furnace mounted on trunnions through which coke oven gas, water gas, heavy oil vapours, or hydrocarbons, and air for combustion are introduced. The charge is heated by an oxidising flame, and sulphur, phosphorus, etc., are thereby burnt off. A bath of molten iron oxide containing some iron is produced, covered by fused slag. The latter is poured off by tilting the furnace, and heating is continued by a reducing flame which reduces the surface iron oxide to the metal. The reduced iron sinks, and the reduction proceeds to completion in this manner. The molten metal may be refined to obtain any desired kind of steel by controlling the flame and adjusting the composition of the charge. In a modification, the oxidising melting only is carried out in a tilting furnace, and the subsequent reduction and carburisation in another furnace. The process is particularly suitable for treating oolitic iron ore which thus yields a good Martin steel instead of a converter steel. See Patent No. 245,223, dated October 13, 1924.

Iron and Alloys

IN a process by H. G. Flodin, of Näsby, Roslags, Sweden, and E. G. T. Gustafsson, of Stockholm, for producing iron and other carbon-binding metals, the oxide ore and carbon, with or without ferro-silicon, ferro-manganese or aluminium, is fed into a slag bath in an electric furnace. The temperature is regulated during reduction by varying the height of the electrodes. During the reduction the upper part of the bath is heated by allowing the electrodes to form arcs between the slag baths and themselves. At the end of the reduction the electrodes are in contact with the bath and just before tapping they are lowered close to the molten metal. Before tapping the slag may be removed and the metal desulphurised and dephosphorised by adding lime, carbon, and fluorspar, and again heating. See Patent application No. 243,743, having the International Convention date, November 27, 1924.

Manganese, its Alloys and Uses

(*Concluded from page* 11)

manganese enters into the composition of black enamels and purple glazes. Slate coloured tiles and bricks are obtained by the colouring action of manganese dioxide and " manganese brown " is obtained by printing cotton with manganese chloride solution and developing the colour with alkali.

It is worthy of notice that manganese workers are liable to poisoning from contact with the finely divided manganese dioxide. Muscular paralysis with salivation sets in, followed by complete loss of the use of the limbs. Manganese poisoning is now scheduled as an industrial disease. Manganese salts are extensively used as driers or siccatives in varnish compounding. For dark oils about ½ lb. of manganese dioxide per cwt. is used, while for pale boiled oils manganese borate, resinate or tungate (from tung oil) are preferred, as they do not darken the oil. The manufacture of permanganates is scarcely within the scope of this article, but their use as disinfectants, oxidising agents, textile bleachers, etc., is worthy of record, in that it accounts for the utilisation of a large quantity of manganese dioxide.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Quarternary alloys. N. Parravano. *Bull Soc. Chim.*, December, 1925, pp. 1485–1521 (in French). Our present knowledge of these alloys is mainly due to the work of the author and his collaborators, and this paper contains a résumé of his investigations.

Contribution to the study of the viscosity of alloys at elevated temperature. J. Cournot and K. Sasagawa. *Rev. Metallurgie*, December, 1925, pp. 753–763 (in French). A discussion of the suitability or otherwise of certain steels and alloys for high-temperature industrial application.

Notes on nickel silvers. W. C. Gray and R. E. Ansell. *Metal Ind. (Lond.)*, January 15, 1926, pp. 56–60 and January 22, 1926, pp. 81–83. Their physical properties and the effect of rolling and annealing thereon are discussed.

ALUMINIUM.—The treatment of aluminium scrap. E. R. Thews. *Metal Ind. (Lond.)*, January 8, 1926, pp. 29–33. A description of the various deoxidising furnace treatments employed.

ANALYSIS.—The separation of tin and antimony, particularly from tin-antimony-lead alloys, by a dry method. W. Lidle. *Metall. u. Erz*, January (1), 1926, pp. 5–10 (in German).

Crucible methods of analysis. J. D. Main Smith. *Chem. News*, January 29, 1926, pp. 65–72.

Rapid detection of small amounts of aluminium in certain non-ferrous metals. G. E. F. Lundell and H. B. Knowles. *J. Ind. Eng. Chem.*, January, 1926, pp. 60–61.

CORROSION.—Progress in the chromium and chromium-nickel corrosion resisting steels industry. W. H. Hatfield. *Ind. Chem.*, January, 1926, pp. 11–12.

Zinc and the problem of corrosion. Part III. A. Billaz. *L'Ind. Chim.*, December, 1925, pp. 541–543 (in French). A final paper discussing the corrosion of zinc by alkaline solutions and describing the applications of zinc to the protection of iron and steel.

The galvanising of iron and steel. E. A. Atkins. *Metallurgist*, January 29, 1926, pp. 9–10. A description mainly of the hot dipping process.

Rust-preventing means. J. Swoboda. *Chem.-Zeit.*, November 20, 1925, pp. 977–979, and November 26, 1925, pp. 994–997 (in German). A description of the various compositions for application to the surface of iron.

ELECTRO-DEPOSITION.—Studies on electroplating. Part VI. Barrel-plating (*continued*). E. W. Hughes. *Metal Ind. (Lond.)*, January 22, 1926, pp. 77–79 and January 29, 1926, pp. 101–103. A description of the mechanical, chemical and electrolytic methods of preparing the work for plating.

IRON AND STEEL.—Sulphur in steel. *Metallurgist*, January 29, 1926, pp. 10–13. Discusses the origin and nature of sulphur inclusions.

Electricity in the iron and steel industry. J. C. Reed. *Iron and Steel Engineer*, November, 1925, pp. 435–451. An illustrated description of the application of electricity to every phase of steel making.

Acid open hearth steel melting practice. R. Furness. Trans. *Amer. Soc. Steel Treating*, December, 1925, pp. 728–738.

The basic open hearth practice. E. A. Whitworth. *Trans. Amer. Soc. Steel Treating*, December, 1925, pp. 739–747.

Iron ores of the world. O. R. Kuhn. *Blast Furnace and Steel Plant*, January, 1926, pp. 2–12. A broad survey of the important ore resources available for the iron industry.

MAGNESIUM.—Magnesium and its alloys. Part I. S. L. Archbutt. *Metallurgist*, January 29, 1926, pp. 4–6. This first paper gives the physical and mechanical properties of the metal itself.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd.—Registered December 16, £2,000 debentures (2nd series), part of £10,000; general charge. *£3,859. July 24, 1924.

SHEEPBRIDGE COAL AND IRON CO., LTD.—Registered January 5, £3,800 debentures, part of £750,000; general charge (except uncalled capital, etc.). *£531,950. October 12, 1925.

SHEPHARD (W. H.), LTD., Sheffield, steel manufacturers.—Registered December 30, £5,000 debentures, to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; charged on company's land at Sheffield, also general charge. *——. August 4, 1925.

UNITED STEEL COMPANIES, LTD., Sheffield.—Registered December 30, £2,000 mortgage, to C. T. Hounsfield, 8, Rue de Lancry, Paris; charged on property at Catcliffe, Rotherham. *£893,850 A debentures, £999,100 B debenture stock, £499,998 C debenture stock, £346,023 1s. 1d. mortgages, etc. November 9, 1925.

YARDE KERRI GROUP TIN MINES, LTD., London, E.C.—Registered December 21, £15,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue, £10,000; general charge. *Nil. August 20, 1925.

Satisfactions

CARGO FLEET IRON CO., LTD.—Satisfaction registered December 30, £10,400, part of amount registered January 23, 1905, etc.

GALLOWAYS, LTD., Manchester, ironfounders.—Satisfaction registered December 23, all moneys, etc., registered August 27, 1912; £5,000 (not ex.), registered November 10, 1913; all moneys, etc., registered August 5, 1915; and £20,000 (not ex.), registered November 6, 1915.

HILL (C. AND L.), LTD., Willenhall, ironfounders, etc.—Satisfaction registered January 8, £5,000, balance of amount registered August 9, 1921.

RAYFIELD (NIGERIA) TIN FIELDS, LTD., London, E.C.—Satisfaction registered January 2, £26,500, registered December 31, 1921.

Institute of Metals' Election

A BALLOT for the election of members and student members of the Institute of Metals will take place on February 24, and persons elected will be entitled to membership advantages for the extended period ending June 30, 1927. Further particulars and application forms can be obtained from the secretary, Mr. G. Shaw Scott, M.Sc., 36-38, Victoria Street, London, S.W.1.

Iron and Steel Houses

IN his speech at Stirling last week, the Prime Minister announced that the Government intended to proceed with the erection of steel houses in Scotland, notwithstanding opposition from certain quarters. Not only was it necessary to make a direct contribution to housing, but, as Sir Arthur Steel-Maitland said in the same connection, the Government wanted to provide work for the iron, steel and engineering trades.

About 2,000 steel houses will be built in Scotland, while it is reported that 250 cast iron houses are in progress for the Corporation of Derby. The iron has been tested by the Department of Scientific and Industrial Research, which has reported favourably on its resistance to moisture and non-conductivity to heat and cold.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business, should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Position of the Metallurgical Student in Industry

Important Discussion at Birmingham

We publish below a report of an important conference held in Birmingham last month, at which representatives of leading universities and industrial concerns discussed the position of the metallurgical student in industry.

AT a conference of metallurgical students held at Birmingham University on February 19 and 20, the subject discussed was "The Position of the Metallurgical Student in Industry." The object of the meetings, which were attended by representatives of university-trained metallurgical students and leading industrial concerns throughout the country, was to promote a fuller understanding and co-operation between works and university departments. With this purpose in view, the discussion centred round three points: (1) the most suitable technical training, where it should be carried out, and how far existing university courses might be modified to provide such training; (2) the mental attitude required and how to inculcate it; and (3) the most suitable means of absorbing the trained student into industry.

The meetings were presided over by Mr. C. E. Moore, who reviewed the history and aims of the movement in connection with which the conference was held, and pointed out it was a students' movement, organised and financed entirely by students. It was gradually, if slowly in the majority of cases, being realised by those who controlled industry that the success of their undertakings depended more and more upon the application of scientific principles to the processes of manufacture, and that the quality of the products of industry would fare better in the hands of men trained at a university. Unfortunately, however, a very large number of firms did not appreciate this fact, and many hesitated to employ "these scientific university gentlemen" because they believed they were of no use when brought into the works and understood nothing about works atmosphere and psychology. It was hoped that the conference would remove a good deal of this lack of knowledge on the part of the directors of many industrial concerns and establish a closer relationship between metallurgical departments.

Schemes of Training

On the question of training, the chairman said that schemes should, to some extent, be planned so as to meet the special needs of particular localities, and certain universities and technical colleges trained almost entirely with this object, Where so many men had to go overseas in metallurgical capacities, however, some provision for special branches might have to be undertaken, but the difficulty was to pick out from among the mass of knowledge those fields that were of use for the training necessary to the competent metallurgist.

Dr. T. B. Crow, who put forward the views of the Birmingham Metallurgical Department, stated the first thing that counted was the works, and in consequence a university metallurgical department should form an adjunct to the works. Some firms were inclined to regard students as self-centred people obsessed by their own point of view, who failed to realise it was the works that must come first, and that university training must be subservient to them. They did not hold the view, with which they were sometimes credited, that the student could go into works and expect to receive a comfortable salary just because he happened to know, for instance, that Neilson invented hot blast, and he submitted that the sort of training metallurgists ought to have was very distinctly realised by the Department. With reference to training in original research, in many cases this could be carried out largely in a works and probably in conjunction with one of the metallurgical research associations.

Mr. Pearce, representing the British Cast Iron Research Association, suggested the period of practical training should preferably be before graduation, though a little training should be obtained after graduation. It gave an insight into works life and discipline, and provided an opportunity for coming in contact with experienced workers. Further, it gave the student practical knowledge, which was so necessary, and brought him to the notice of the employer, in whose power it was to give him a job. An employer did not care to engage a man of whose worth he knew nothing. It was not advisable to remain in the university on research work after graduation, unless they were prepared to undertake such work permanently. The provision of bursaries should be encouraged, and eventually employers might give maintenance grants. Training might be more of an engineering than of a scientific character.

Works Psychology

As to the mental attitude by means of which the student could regard works problems from the points of view of quality and quantity of output, Dr. Crow thought that this attitude could be brought about during pre-graduate training through the inclusion of suitable subjects other than those directly related to metallurgy, and through the insistence of six months' full-time works experience. Much time should be devoted to such subjects as accounting, costing, works organisation, and administration, and the question of human relationship in industry was no less important.

Dr. R. S. Hutton, Director of the British Non-Ferrous Metals Research Association, emphasised the importance of a closer relationship between the university metallurgical departments, and pointed out that in Germany and the United States of America the value of this factor was realised to a greater extent than in this country.

Absorption into Industry

In order to maintain our proper position in the industrial world, he said, we must keep to the level of absorption of university-trained men as had been reached in those countries. Better material in the way of university graduates was being turned out in this country than in America, but our power of absorption was less. In the case of a large American electrical concern 400 university graduates were accepted into the works, and half of this number remained permanently in employment. There were many instances in this country of university-trained men who had made good, and by their success had made the work of others easier. The success of many men in industry depended very much upon their right appreciation of the economic factor, and it was highly important that they should get an all-round view of the organisation of industry.

Professor Turner said there had been a great advance in this country during the past 25 years in the recognition of the value of university-trained men to industry. At the time of the establishment of the department at Birmingham University there were no trained metallurgists available, and naturally none was employed in the local works. Now quite a large number of trained men were employed there, and the number was steadily increasing. One important thing that had been established in the district was friendship between the large manufacturing concerns and the university. It had to be remembered that a student who was absorbed into

industry represented his university, and that he was working not only for his own good, but for the good of those who came after him.

Procedure Suggested

By way of summarising the course of procedure that was considered desirable for the fully-equipped student seeking entry into industrial life, and for bridging the gulf existing between the metallurgical department of the universities and works, several resolutions were submitted to the conference. "That university training should be organised as an aid to works' requirements" was unanimously approved, and a motion suggesting that a suitable mental attitude could be "inculcated partly through the medium of vacation courses and partly by means of lectures, particularly by industrialists, on such subjects as human relationships in industry and works organisation and management" was also passed. A resolution stating "that one of the most important objects of a university training is the development of personality and character" was agreed, as also was a proposition suggesting that a minimum period of six months should be spent before graduation in acquiring full-time works experience, but that if this experience be obtained before entering a university the time might be profitably extended.

Another motion adopted was "that the most suitable method of entry into industrial life is by means of a probationary period of one year, during which a self-supporting wage should be received; this method is intermediate between the apprenticeship system, with its accompanying low wages, and that of the attainment of an immediately remunerative post." A final resolution requested a definition of the distinction between a works chemist and a metallurgist, and expressed the view that the latter would be usually of greater value to industry, if employed in some other capacity than that of a routine chemist.

Fatigue of Metals: Its Influence on Mechanical Design

In the following article the fatigue of metals and its bearing on structural weakness is briefly discussed, and attention is drawn to some recent research in this field.

With the modern trend towards higher speeds, heavier loads and lighter structures the phenomenon of fatigue assumes increasing significance. This is particularly the case in railway car axles and the members of iron railway bridges, where failures used to be common. In such cases there was usually a sudden failure without prior evidence of weakness, under conditions of service which were not abnormal. Very often the failed member had broken off short, with a partly crystalline fracture, and without general distortion; subsequent investigation has often shown high ductility in the metal.

The Nature of Fatigue

As all failures of this type occurred in members subjected to frequently repeated stress the phenomenon was termed "fatigue." The investigations of many metallurgists have led to the following conclusions:—

1. A machine part, or structural member, may be ruptured by the repeated application of a load which induces a computed fibre stress less than the ultimate strength of the material as determined by static test.

2. The greater the range of stress the lower the limiting fibre stress to ensure against rupture after a very large number of repetitions.

3. To ensure against rupture after a very large number of repetitions of loading causing complete reversal of stress, the limiting fibre stress is but little greater than one-half the limiting fibre stress for a very large number of repetitions of stress varying from zero to a maximum.

The number of repetitions of stress which the structure of the past century was called upon to withstand, some ten to fifty million perhaps, are not comparable with the requirements of modern structures. For instance, a car axle of to-day may be called upon to meet 50 million repetitions of stress in its lifetime, the motor car engine crankshaft 120 million, line shafting in machine shops 360 million, while the bending stresses in steam turbine shafts may be considerably higher in number.

The theory advanced that metal under repeated stress changed from an originally fibrous structure to a crystalline one, based largely on the fibrous appearance of wrought iron, is erroneous, because the grain structure of iron and steel is entirely crystalline, the appearance of wrought iron being due solely to the elongated slag inclusions. The diminished resistance to fracture resulting from repeated applications of stress is unaccompanied by change in grain structure, but is due altogether to a breaking down of the individual grain itself. The grains taking the most stress, or with the lowest elastic limit, are deformed by the slipping of one portion of the grain relatively to other portions. The slip bands, or lines, so developed extend across the crystals, ultimately becoming actual cracks across the entire grain, a condition which promotes the extension of the crack into adjacent grains on both sides, usually along the lines of cleavage of each individual grain, and the ultimate development of a rupture.

Fatigue, therefore, is really a progressive breaking down of the grain itself, following natural fault planes. It originates where the stress is greatest and in the structurally weakest grain. Any outside factor, therefore, that tends to localise stress is to be avoided. A re-entrant angle or other irregularity in contour is a possible starting-point for failure by fatigue. Internal flaws and inclusions may be a potent factor in localising stress.

In recent years the most comprehensive investigation of the fatigue of metals is that still being conducted by the University of Illinois Engineering Experiment Station, in conjunction with the American National Research Council, the Engineering Foundation, and the General Electric Company, and the author is indebted to the Armco International Corporation for details of some of the conclusions that have already been arrived at in these studies.

One of the most interesting of the results, confirmed by the U.S. Naval Experiment Station, is the high ratio of the computed stresses at the endurance limit to the proportional elastic limit developed by ingot iron under many repetitions of stress. In the rotating beam test this ratio for ingot iron was almost 1·5, the endurance limit being 33 per cent. higher than the average yield point in tension and compression. The performance of pure iron can be greatly improved by water-quenching both as regards static strength and endurance limit, the latter being raised as much as 20 per cent. The ingot iron specimens withstood without fracture 104·5 million cycles before rupture at a unit stress of 26,000 lb., 7,100 lb. above the yield point of that material.

In some tests carried out by the Inspection Department of the Union of South Africa on ingot iron $\frac{5}{8}$ in. rounds to find the value of this metal for locomotive boiler staybolts, the specimens withstood 7,000 vibrations before fracture. A measure of this performance is indicated by the fact that the best Yorkshire iron is considered good if it will withstand 12,000 vibrations.

Metal Worker's Bravery

It was announced in Tuesday's issue of the *Gazette* that the King has awarded the Edward Medal to Alfred Welding, a workman employed by High Speed Steel Alloys, Ltd., for bravery in the following circumstances:

On October 1, 1925, a youth named Harper employed at the company's works at Widnes, fell into a vat 6½ ft. high and 8 ft. in diameter containing vanadic acid, and though his head was clear of the acid, was quickly sinking and would have been submerged in a few seconds. Welding ran to his assistance and without hesitation jumped into the vat and, by holding up Harper, prevented the latter's complete immersion. It was some three or four minutes before help arrived, and both men were severely scalded before being dragged out. But for Welding's action the boy would certainly have lost his life.

Determination of Arsenic in Steel

An Improved Volumetric Method

THE many published methods for the determination of arsenic in steel and iron all depend, with one or two exceptions, upon the principle of the quantitative distillation of arsenic as arsenic trichloride in the presence of hydrochloric acid. The arsenic is first obtained as arsenic acid by the evaporation of a solution of the metal in dilute nitric acid, with or without the presence of sulphuric acid. The residue resulting from this evaporation, consisting of basic ferric salts, is then taken up with excess concentrated hydrochloric acid, cuprous chloride or ferrous sulphate added, and the whole quantitatively distilled. The resulting distillate contains all the arsenic as arsenic trichloride in a strong hydrochloric acid solution, which may be determined either volumetrically or gravimetrically, the latter being the more common method employed when appreciable quantities of arsenic are present. The usual procedures, however, practically all have the disadvantages of multiplicity of operations, with consequent consumption of time. A more rapid and at the same time reasonably accurate method for this determination is described by A. E. Cameron, of the Massachusetts Institute of Technology, U.S.A., in *Industrial and Engineering Chemistry*. The method is a modification of Mohr's procedure, as follows :

Practical Procedure

Dissolve 5 gms. of steel drillings in a 500 cc. round-bottomed flask by the gradual addition of nitric acid (1·2), cooling under the tap to prevent too violent action. When action ceases, place on a sand bath or hot plate, heat gradually until the solution clears, and then evaporate to dryness and bake until the red nitrous fumes are completely removed. The addition of a few crystals of potassium permanganate is recommended, and nitrous acids may be removed by the addition of ammonium oxalate.

Cool the residue from the evaporation, take up with 100 to 150 cc. of concentrated hydrochloric acid, warming gently to aid solution. Cool the clear solution, add 20 gms. cuprous chloride, connect the flask to a spiral condenser, and distil. The separatory funnel for the distillation should have a stopcock. The outlet tube should be provided with a hole on the side about 1 cm. from the opening at the end within the distillation flask, to allow for circulation in the outlet tube and thus prevent small particles in the flask from passing over into the distillate. The tip of the condenser should dip about 1 cm. into 100 cc. of water contained in a 400-cc. beaker, and the latter should be suitably cooled. The distillation must be carried out slowly. If brown fumes appear in the flask, nitrogen acids are still present and the determination must be rejected. When about 60 to 75 cc. have been distilled over, remove the flame, cool, and add 50 cc. of concentrated hydrochloric acid to the flask. Resume distillation until a further 50 cc. has distilled over. These two distillations should be sufficient to volatilise all the arsenic as arsenic trichloride.

Make the distillate alkaline by means of a strong solution of sodium hydroxide. Make slightly acid with concentrated hydrochloric acid and neutralise with excess sodium bicarbonate. Cool to room temperature and titrate with a standardised iodine solution, using starch as indicator. Prepare the iodine solution by dissolving 1·275 gms. of iodine and 2 gms. of potassium iodide in 1 litre of water. This solution must be standardised with a standard arsenic solution, which may be prepared by dissolving 0·66 gm. of arsenious oxide in about 10 cc. of concentrated hydrochloric acid, solution being obtained readily without boiling. Dilute the solution with a little water, neutralise the acid with excess sodium bicarbonate, and then dilute to 1 litre.

Test Analyses

It is obvious that arsenic-free reagents must be used, and a blank test should be made on the same quantities of acids and salts as are used in the determination, the amount of iodine consumed being deducted from the results of the determination.

As a test of the method, 0·025 gm. of arsenious oxide was dissolved in 90 cc. of concentrated hydrochloric acid, 20 gms. cuprous chloride added, and the solution distilled. After about 70 cc. of the solution had distilled over, 25 cc. more acid was added and the distillation continued until a further 25 cc. of distillate had collected. At the same time a blank was run on the reagents used. Titration gave :—

	Arsenic, Gram.
In solution	0·0195
In reagents	0·0007
Arsenic returned	0·0188
Arsenic added	0·0189 (0·0250 × 0·7571)

A Bureau of Standards standard steel sample with arsenic given as 0·012 per cent., yielded on tritration, 0·009 per cent. and 0·010 per cent.

The Legendary "White Metal"

Results of American Tests

IT has now been determined that the mysterious "white metal," which many mineral prospectors in the West of America still consider to have strange properties of hardening iron or steel when heated in contact with those materials, has no existence in fact, following repeated experiments by the U.S. Bureau of Mines with purported specimens.

This metal is the subject of an interesting legend, according to which Mexicans and other old settlers in the south-western states knew of an "ore" which was packed around pieces of iron or steel that they wished to harden. The whole was heated in a wood fire and then quenched in water. Axles of springless wagons so treated were said to have been made glass hard, and to wear two or three times as long as ordinary axles, and tyres so treated were described as "ringing like a bell" when suspended and struck with a hammer. This action was said to be due to a "white metal" that was extracted from the "ore" and alloyed with the iron by the treatment. Although this story has never been shown to have had any fact as a basis, it appears from time to time under slightly different guises. As a result, for over twenty years many kinds of rocks have from time to time been forthcoming, which have been claimed to give remarkable properties to metals such as making them extremely hard and tough, or resistant to corrosion. Many of these are igneous rocks, such as altered diabase, olivine, pyroxenite, obsidian, basalt and amphibolite. Pyritic quartzite, magnetite, tourmaline, and sandstone have also been received. Most of the samples come from California and Nevada, but they also come from nearly all other western states.

Extraction of the "Metal"

The recommended method is usually to heat the rock in contact with metal to be treated, supposing that a "white metal" is produced from the "ore" which alloys with the metal being treated. The temperatures used have ranged from 200° F. to that of the electric arc. The favourite heating device is the blacksmith's forge. In some cases the extraction of the "white metal" itself has been described as having been performed by simply melting the "ore," in others by melting with fluxes, or by melting with fluxes and a reducing agent.

The laboratory of the rare and precious metals experimental station of the Bureau at Reno, Nevada, has in the past few years received various samples of the reputed "white metal," some of the claimants presenting their samples in person and endeavouring to demonstrate the virtues of their process. As was to be expected, the results indicated that work and money put into schemes involving this mysterious metal would be wasted. The tests by the Bureau have usually shown no hardening effect, although in a few tests some hardening of iron or steel was produced due either to case-hardening from heating the metal in contact with carbon, protected from oxidation by a coating of flux, or in some instances to the formation of a crude silicon alloy. Many ordinary fusible rocks, and even fluxes without rock, will give these same results. Some claims of glass hardness for treated metal have obviously been based on hard slag which stuck to the metal being mistaken for hardened metal. The protection of treated iron against corrosion was sometimes improved by purifying the iron.

Further details are given in Information Circular No. 6000, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Works Practice for Students

THE necessity of including a course in works practice as a part of the training of scientists who are to be connected with industry is being recognised to a greater extent than ever before, and the conference on the metallurgical student in industry held a few weeks ago at Birmingham was a timely contribution to this important subject. Organised to promote a fuller understanding between works and university departments, the conference passed some interesting resolutions summarising the procedure required in the training of metallurgists for industry.

While a thorough grounding in the principles of a science is absolutely essential, it was agreed that training should be organised as an aid to works requirements, and it was suggested that a minimum period of six months should be spent before graduation in acquiring full-time works experience. Although it is unlikely that this procedure can as yet become the general practice, there is a growing tendency in this direction, an instance being the vacation courses organised—in the field of chemistry—by the British Dyestuffs Corporation. Once again that concern is offering first-hand experience to students during the coming summer, and it is to be hoped that metallurgical firms will follow this admirable example. Not only is such practice of immense value to the student, but it also benefits the industrialist, who ultimately has to rely on the universities for his source of trained technologists.

Institute of Metals: New Articles

THE Institute of Metals has just issued to members a ballot paper containing the names of 77 candidates for membership—a record list. In future election to membership will be by the Council—assuming that the new Articles recently drawn up by the Council are approved at the meeting to be held on March 11. These Articles were drawn up, we understand, primarily to do away with the postal ballot system in which there was returned only about ten per cent. of the voting papers. Members will still have an opportunity of objecting to any application, as names of the approved applicants will be exhibited. Copies of the lists are to be supplied to the Secretaries of Local Sections of the Institute for inspection. Power is also sought to vary the constitution of the Council. The most important change is that which provides that the Chairman of any Local Section may be co-opted a member of the Council. The six past presidents who shall be *ex-officio* members of the Council will be limited to the six most recently retired from the office of president. The election of the Council will continue to be by postal ballot. The first election of members under the new arrangement is proposed to be held on April 21.

Beryllium as an Alloy Metal

THE literature of the light metals grows apace, a circumstance not to be wondered at, considering the demand which the progress of aeronautical engineering is making, and must continue to make, for metals and alloys combining, in the necessary degree, lightness and strength. The melting point of beryllium (or glucinium, as it is called on the continent) is about 1,280° C., whereas that of magnesium is only 650° C. It would, therefore, be exceedingly difficult to obtain an alloy of these two metals. The problem is not, however, an insoluble one, if indirect methods were employed, as magnesium and manganese (which has a melting point of 1,245° C.) can be, and are, harnessed together in the material known as manganese-magnesium-silicon. As the modulus of elasticity of beryllium is over seven times greater than that of magnesium, an alloy of these metals should display a tensile strength which would probably be higher than that of any known metal, and, theoretically, the hardness of such a material would also be exceedingly high. Estimates as to the specific gravity of beryllium differ, as even so-called pure samples of the metal are apt to be contaminated with iron, silicon, and other impurities. They range from 1·64 (which is lower than that of magnesium) to 1·8, which is higher. In any case, the specific gravity of both metals must be very similar, and as they both belong to the same group, their chemical behaviour will be more or less similar as well. The present price of beryllium is exceedingly high, but an eminent American authority believes that this is an artificial condition and that, with improvements in its manufacture, and a correspondingly adequate demand, the price, although high, would no longer be prohibitive of the use of the metal in special cases where cost is a secondary consideration. An association exists, in Germany, for the scientific study of the metal, and its manufacture is actually undertaken on a commercial basis in France and in Germany at the present time. The most plentiful of the minerals constituting its ores is beryl, which contains rather less than 8 per cent. of beryllium. The richest, phenacite, is somewhat rare. It contains about 24 per cent. of beryllium. Whatever the future may bring forth, there is no doubt that beryllium, which is attracting much attention on the continent at present, is destined to play an important part in the production of the light alloys about which so much is being written and said of late.

Fuel Economy in Metallurgical Works

METALLURGICAL furnaces in which metals are remelted, reheated and annealed, as distinct from those in which metals are actually reduced from their ores, such as blast-furnaces, are notoriously heavy consumers of fuel. Indeed, the average fuel consumption per ton of finished steel, which reaches, according to the admirable statistics compiled by the National Federation of Iron and Steel Manufacturers and recently given in evidence before the Coal Commission, the unduly high figure of nearly four tons (from ore to finished sections), is partly swollen to this astonishing figure by the inclusion of the coal consumed in the crucible steel processes. The open-hearth furnace, again, is an inefficient apparatus from the point of view of fuel economy, and the utilisation in such furnaces of waste heat boilers is only a partial solution of the problems involved. In cupola practice, likewise, there is room for the utilisation of waste heat. These and other problems of fuel economy have hitherto been considered from a piece-meal point of view; they are not the immediate objects of any society or institution, but are, vicariously, the object of the spasmodic and desultory attention of a number of such institutions, to which they are of subsidiary interest only. It is to be hoped that the new proposed Institution of Fuel Technology will be able to co-ordinate in the way it should be done, the host of problems which collectively constitute the field of fuel technology. It is true that there is another Richmond in that field, in the shape of the almost equally new Institution of Fuel Economy Engineers, which has its present headquarters in Nottingham. The multiplication of Institutions is as much to be deprecated as the lack of any specific one of them. Probably, as the result of the important meeting held yesterday at the Institution of Civil Engineers, a *via media* will be reached. There is a great need of an Institute which shall make this field its own, and in no direction will it find greater justification for its activities than in the metallurgical industries.

An Example from Staveley

IN the meanwhile striking exemplification is afforded of the fact that no corporate body, and still less—it may well be believed—any Government Department, Bureau, or Commission can hope to vie with private enterprise, conducted with prevision and skill, in providing industry with solutions of its own problems. The particulars recently made public in respect of developments at the works of the Staveley Coal and Iron Co., Ltd., of Chesterfield, are attracting widespread attention. These works are particularly interesting to chemists and metallurgists alike, as they represent the natural and scientific conjunction of the carbonisation of coal, the smelting of iron ore, and the adequate utilisation of the by-products of both processes for the provision of power and the manufacture of chemicals. At hardly any other works in the country is the liaison between the metallurgical and the chemical industries better organised or more efficiently directed. The latest development is on entirely novel lines. It is the employment of the blast furnace gases in large gas engines

which is, of course, no new practice in itself, although the gas engines at Staveley are the largest of the kind ever installed in the country. The novelty consists in the utilisation of the hot exhaust gases from the gas engine, for the heating of water-tube boilers, and the consequent production of high-pressure steam. The process of the utilisation of the waste heat of the gas engines does not, however, stop there, for it is put to a use which is, for the moment, unique, and marks a most important stage of development. A portion of the hot exhaust gases traverses a system of retorts for the low-temperature carbonisation of colliery waste of the very lowest grade. No attempt is made to produce a residual semi-coke or smokeless fuel; the low-grade coal used in the Markham retort does not lend itself to this. It is, however, stripped of its oils in a most economical manner, seeing that the heat necessary for the process can be so cheaply generated and so economically applied. The whole process was described by Mr. David Brownlie, in a paper read a few days ago before the Midland Counties Institution of Engineers, and the lessons to be derived from the practice at Staveley, which is due to the inventiveness and resource of Mr. Charles Markham, are such as all metallurgists and fuel engineers will do well to lay to heart.

Copper-Zinc-Nickel Alloys

THE brasses containing nickel are a valuable series of alloys for which modern industry has found many applications. From a metallurgical point of view their manufacture is not easy and their structure is at times difficult to control. F. M. Ostroga has given some very interesting details relating to three samples which had the following compositions :—

	Percentages.			
	Cu.	Ni.	Pb.	Zn.
Alloy A ..	50·42	6·25	0·17	42·9
Alloy B ..	44·70	10·34	0·21	44·10
Alloy C ..	39·65	14·75	0·17	45·20

At ordinary temperatures the three alloys showed, in each case, two constituents: one, white and crystalline, and the other dark. These were the α and β forms, the β being apparently the eutectoid, although, as in most of the brasses, ill defined. The higher the temperature at which such metals are annealed the more definitely granular does the β constituent become. The melting and solidification points of the three alloys were, respectively :—

A	900° C.	870° C.
B	905° C.	865° C.
C	915° C.	875° C.

The figures are only approximate as it was found practically impossible to prevent the zinc from volatilising or oxidising. A remarkable point in regard to these nickel-brass alloys is the existence of transformation points that very greatly affect the hardness. These occur in the solid solution; the liquid range, as may be seen from the above table, is somewhat narrow. It is evident that quenching stabilises the conditions which obtain at the temperature to which the alloys have been heated prior to quenching. Heat treatment is, however, powerless to induce a martensitic structure; nor could the β constituent be satisfactorily resolved. Some of the anomalies in the heating and cooling curves are obviously closely connected, as has been suspected by previous investigators, with the volatilisation of the zinc, and this is, of course, dependent on the degree to which the alloys are heated before cooling. Thus, an alloy heated for 20 minutes at 800° C. will lose more zinc than an alloy which has been heated for two hours at 770° C.

Extensive American Research

AN instance in which metallurgical firms are co-operating with a technical college in the training of students for industry was referred to last month in these columns. With a view to assisting the technical staff of the Pittsburgh station of the U.S. Bureau of Mines, the Carnegie Institute appointed an advisory board composed of prominent metallurgists connected with industrial organisations in the district, and some of the investigations are being conducted in local works.

The extensive nature of the research undertaken by the Bureau of Mines is evidenced by a prospectus of the work planned for this year received from Washington. In the course of a study of the composition of copper smelter slags, being conducted at Tucson, Arizona, work is being continued on methods of determining magnetite, to the presence of which some metallurgists attribute much of the loss of copper. As a final proof, it will be attempted to determine directly if magnetite is the only form in which iron is present in the ferric condition. This will be done by passing hydrogen over the heated slags, weighing the water evolved, and comparing this amount with that which should form as shown by the magnetite determination. Microscopic studies will also be made on polished sections of slag to determine whether any ferric iron other than magnetite is present.

Research is also being conducted on acid manufacture in the ferric sulphate-sulphuric acid process. One important stage of this problem has been completed. The sulphuric acid-ferric sulphate solvent, containing about 6 per cent. acid, was made in ton lots by a simple process that is cheap to install and operate, roaster gas being blown directly into a ferrous sulphate solution through a woollen cloth diaphragm. Other promising methods are to be tried, among which are the use of a pipe grid containing many small holes, and impeller types of aerators. The next important step will be actually to try the acid-making process as one of the stages fitting in with a percolation leaching cycle, and in this way the process may be established as a whole in the shortest space of time.

On the question of copper precipitation by sponge iron it is intended to conduct the semi-commercial precipitation, using the solutions obtained by leaching copper ores with ferric sulphate and sulphuric acid in the pilot plant. Pyrite is now being "dropped" in increasing amounts by differential flotation, and there exists a waste source of both iron for sponge iron and sulphur dioxide for making ferric sulphate-sulphuric acid.

Terminology of Tensile Properties

THE unsatisfactory and confused terminology of tensile properties has long been recognised, and is a frequent source of confusion in the literature of metallurgy. It was the subject, not long ago, of a lengthy criticism by two well known Italian metallurgists, Drs. Prever and Balma, in an important paper on "Fatigue Loads and Safety Limits," and it has come in for similar adverse criticism at the hands of the distinguished Russian scientist, Professor Babochine. He gives the following list of expressions used in the literature, which may mean different things, or may, by some authorities, be employed almost as if they were synonyms.

(*a*) Elastic limit.
(*b*) Elastic limit of proportionality.
(*c*) Lower elastic limit.
(*d*) Upper elastic limit.
(*e*) True elastic limit.
(*f*) Natural elastic limit.
(*g*) Unstable elastic limit.
(*h*) Limit of flow.
(*i*) Apparent elastic limit.
(*j*) Practical elastic limit.
(*k*) Critical region, or point.

This list, although formidable, is by no means exhaustive. Allowing for the possibility that some of these terms correspond, somewhat haphazardly, with some of the following, the list below is taken from one of the latest, and incidentally one of the best recent books on the strength of materials, by Mr. John Case :—

(*a*) Limit of linear elasticity (elastic limit). This is referred to as "the limit of proportionality between stress and strain."
(*b*) Limit of perfect elasticity.
(*c*) Yield point *a*.
(*d*) Yield point *b*.
(*e*) Primitive elastic limit.
(*f*) Natural elastic limit.

These are the accepted terms, and probably the irreducible minimum, in the English language. Some really authoritative statement as to what they actually mean, and how, where possible, they are definitely to be distinguished from each other, is sadly required. In the meanwhile "elastic after effect"; "elastic fatigue"; "plastic flow point," and "viscous flow point" are a few of the remaining terms associated with the behaviour of materials under tensile stress, to say nothing of the host of synonyms for the disruption which occurs when the tensile stress has been applied with sufficient severity, or sufficient time to exert that effect.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

ALTHOUGH we were very guarded in our expression of optimism last month, yet even that tentative forecasting of an improvement in trade has proved to be hardly justified. The somewhat brighter tone evinced in January has followed the old course in February, and once again we are left in a state of uncertainty and lack of confidence. We have heard February described as a critical month and it has not belied this reputation. Reports are circulated from time to time which seem to give the impression that the position, though quiet, is hopeful, but those who know the inside of the trade do not share this feeling. Indeed, the future of the steel trade is more doubtful than ever. A contemporary this week refers to the parlous state of the industry and can see no alternative but the closing down of the less efficient plants and so concentrating the available orders in those which are best fitted to produce economically, owing to their up-to-date equipment, and to deliver cheaply. We are afraid that this procedure will be brought about by one of two causes. Either the steel makers will get together and, in a manner similar to that adopted by the continental makers, come to some arrangement whereby the fatal competition of one works with another can be ended; or the continued selling of steel at prices considerably under cost will lead to the bankruptcy of those works which persist in it.

The Cause of Present Conditions

Various explanations are given to account for the present conditions. The unsettled state of affairs on the Continent, and the depreciated exchanges of France and Belgium are freely referred to, and they certainly have an important influence. Competition from these quarters is severe and is a deterrent to any marked advance in prices here, either for home or export trade. The coal situation is also a disturbing factor.

Whatever may be the influence of these causes, there can be no doubt that one of the chief factors that militate against a recovery is the largely increased productive capacity for which orders are not available. It prevents prices from being increased and it also prevents costs from being reduced as they might be. We firmly believe, and this belief is confirmed in many quarters, that an upward move in prices would bring out more work. It is stated that there is an appreciable amount of shipbuilding orders to be placed with this country, chiefly from America, but until it is known that the bottom level of prices here has been reached the orders are held back. We would not like to say that the bottom has been reached. The entry of a new company into the market with new works marked a definite stage in the forcing down of prices. Prior to that there had been some signs of a firmer tendency, but the addition of another large plant to those already in existence which simply had to find work meant that better prices were out of the question. In plates, for instance, the price had increased slightly to £7 17s. 6d. or even £8 and there was some hope that that would be maintained. But a good order can be placed anywhere now at £7 12s. 6d. and we are not sure that that price will hold for long.

Another New Plant

It is announced in the Press that the Appleby Iron Co. have received a guarantee of £650,000 under the Trade Facilities Act towards the cost of their new plant for making steel plates. But there are already more plate mills in the country than appear to be needed, more than there is work for, and it is difficult to see on what grounds the guarantee has been given. We understood that assistance from the Trade Facilities Act was given in cases where an increase in employment might result, but not in cases where the new construction might result in displacing employment. Yet that the latter is what this new plant may do is evidenced by a resolution protesting against the grant which was passed by the Tees Conservancy Commissioners at their meeting at Middlesbrough on Tuesday, on the ground that there was already an excessive number of plate mills which could not find sufficient work, and any additions at present would have a detrimental effect in the Tees-side district.

This matter brings us back to the suggestion to which we referred at the beginning, co-operation among the manufacturers to reduce the internal competition. In view of the facts we have stated, the prospects of this co-operation are not rosy, and we are inclined to think that the various works will go on struggling to secure orders until forced to drop out; and every increase in productive units will hasten this end for the less fortunate. At the annual dinner of the London Iron and Steel Exchange some comfort was taken from the fact that steel makers had reduced their selling prices to 18 per cent. above 1913, which it was stated had been achieved by co-operation between employers and workers. We wonder! It might be interesting to know how much of this achievement has been forced on the steel makers by the scramble for orders. The workers' part has been chiefly to see their wages slowly declining by the operation of the sliding scale, until such a point has been reached that in certain cases it has been necessary to suspend the operation of the scale to enable the men to live. That may be called co-operation, but it is better to see the facts in their true light and not throw any glamour over what is really happening.

The Month's Business

Conditions during the month in the iron and steel markets have not been encouraging. Business has been quiet with comparatively little buying beyond immediate needs. Taking them all round, the works are less busy than they were a month ago and prices are certainly weaker. Even on the special qualities the margin is being slowly whittled away. Acid boiler plates, for example, are being sold by some makers at prices 30s. below the official Association price, and it seems probable that these low quotations will set the standard for the market. Pig iron has not been quite so bad as the rest of the trade, but that is not bright. Prices have remained comparatively firm, but the demand is poor, as many of the consumers have laid in stocks at the recent low prices and there is some difficulty in disposing of even foundry iron. Forge iron is very quiet. Hematite is unchanged in price but business is decidedly less active than at the beginning of the year. Nevertheless the number of blast furnaces in operation is about to be increased. Dorman Long and Co. are to blow in an additional furnace, and Bolckow Vaughan and Co. are getting another furnace ready for lighting. The Appleby Iron Co. will start another furnace very shortly. The chief item in the market for steel billets is the resumption of continental competition. Supplies are being freely offered at prices ranging from £5 to £5 10s. per ton delivered and many of the English works are taking advantage of them. In sections, bars, and plates the position is practically unchanged. Forward buying has fallen off considerably, and purchases are confined to present needs.

The placing of the railway orders for wagons will be of some use to the steel makers. Most of the wagon builders are quite busy. There have been further large orders for wagons placed during the month by the Egyptian State Railways and the Buenos Aires Western Railway in addition to the home orders. The production figures for January are slightly better. Pig iron amounted to 533,500 tons compared with 503,400 tons in December. There were three more furnaces in blast at the end of the month than at the beginning. The output of steel ingots and castings was 635,700 tons compared with 606,800 tons in December.

Important Works Extension

AN important extension of the works at Derby is being undertaken by International Combustion, Ltd. A new foundry section for heavy castings, with core drying ovens, pattern shops and storage, cupolas and complete range of modern handling equipment, is to be started at once. The extensions will also include an entirely new machine shop, and further premises for the fabricating of sheet metal work, bunkers, cyclones, etc. Provision has also been made for extending the transport system to the new buildings, and the total value of the work is estimated to be about £100,000.

At the Barrow works, the firm announces, so many orders for "Raymond" pulverisers have been received this year that additional machinery is to be installed immediately.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Deoxidation of Ingot Iron and Steel

ACCORDING to a process by W. Tafel, of Breslau, Germany, ingot iron and steel are deoxidised by adding a small quantity of welding slag to the finished molten metal in the crucible or in the ingot mould. See Patent No. 245,486, dated September 18, 1924.

Aluminium

APPLICATION has been made by Metal Research Corporation, of New York, for a patent for a dry process of extracting aluminium from alumina. A charge of alumina, coke or charcoal, and carbonate or aluminate of sodium or potassium, is treated in a blast furnace. The alkali salt is decomposed and sodium or potassium is formed. This is oxidised in the upper part of the furnace, carried down with the charge, and reduced again. Sufficient sodium is eventually produced to reduce the alumina to aluminium. See Patent Application 245,421 having the International Convention date, December 30, 1924.

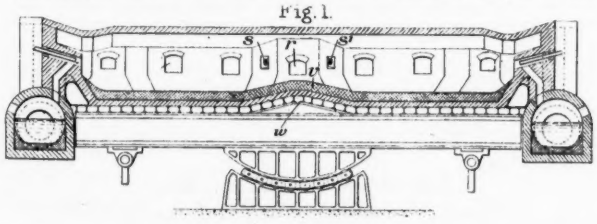
Molybdenum Alloys

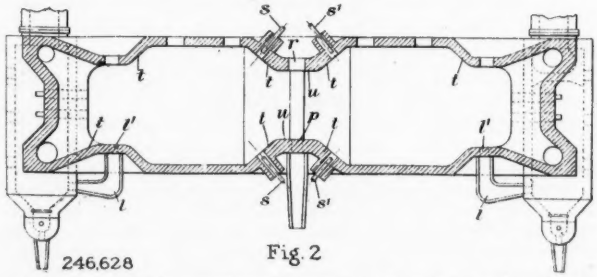
MOLYBDENUM is added to molten iron or steel in a fused mass made from molybdenite by roasting, and then sintering, and containing molybdenum oxide and fluxing material such as lime, fluorspar, silica, and iron oxide. The molybdenum oxide is reduced by the reducing agents in the bath. See Patent Application 245,422, by Molybdenum Corporation of America (of Pittsburgh), having the International Convention date, December 30, 1924.

Metallurgical Furnaces

A METALLURGICAL furnace invented by B. Talbot, of Middlesbrough, is provided with one or more upward transverse bulges of the hearth *v* and of the furnace casing *w*. A tap hole is provided in a side wall at the level of the bulge. There may also be a lateral constriction or re-entrant bulge *t* in the side walls in which a tap hole *p* is provided, with an aperture *r* in the opposite wall. Other constrictions with tap holes t^1 are provided. The charge can thus be tapped at one or more intermediate points to such a level as will leave the greater part of the bath in the furnace. The re-entrant bulges in the

Fig. 1.



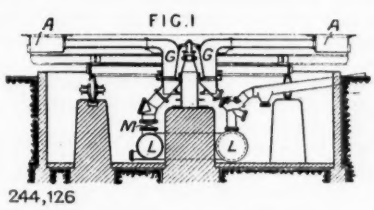


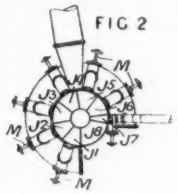
246,628 Fig. 2

side walls enable auxiliary burners *s*, s^1 to be employed in a very long furnace. See Patents Nos. 246,627–8, dated December 5, 1924.

Treating Ores

IN an apparatus by Metallbank und Metallurgische Ges. Akt.-Ges. of Frankfurt-on-Main, for sintering and desulphurising ores, a number of segmental boxes A are connected to suction pipes G, the lower ends of which move over compartments J^1—J^8. The compartments J^1—J^6 are connected to the main suction pipe L, and the compartment J^7 with the ignition means. The fresh charge is supplied to that box A which is connected to the compartment J^7 and is then subjected to suction which progressively increases by moving successively over the compartments J^6—J^1. Compartment J^8 is not subject to suction, and the charge is then discharged. See





244,126

Patent Application 244,126, having the International Convention date, December 6, 1924.

Alloys

ACCORDING to a process for making stainless iron or steel or ferro-chromium, by W. B. B. Penniman and E. J. Shackelford, of Baltimore, U.S.A., a bath of molten iron is made in an electric furnace and covered by a reception slag of lime and fluorspar. A crushed mixture of ore, flux, and coke or anthracite, is fed into the bath, and the slag is removed when about half the charge has been reduced. When the last smelting slag has been removed, lime and fluorspar are added, and then chromium ore. Ferrosilicon or other alloy is then added to the surface of the decarburising slag, which is finally removed and the metal covered with powdered lime and tapped. See Patent Application 244,413 having the International Convention date, December 11, 1924.

Refining Lead

APPLICATION has been made by H. Harris, of London, for a patent for a process for removing arsenic, tin, or antimony from lead by an oxidising agent comprising an oxysalt of one or more metals capable of combining with the metallic mass and having less affinity for oxygen than has the metal to be removed. The spent reagent used for treating metal with caustic alkali and sodium nitrate may be used as the oxidising agent. A reagent containing sodium antimonate, caustic soda, and sodium chloride extracts tin and arsenic as sodium stannate and arsenate, the antimony passing into the lead. See Patent Application No. 244,424, having the International Convention date, December 11, 1924.

World's Largest Non-Ferrous Smelter

THE group of plants of the Consolidated Mining and Smelting Co. of Canada, situated at Tadanac, is now the largest of its kind in the world outside the iron and steel industry. With the bringing into full use during last year of the zinc plant and lead refineries using the hydro-electric power generated at Lower Bonnington Falls, on the Kootenay river, Tadanac has become the world's most important non-ferrous metallurgical plant. Altogether the West Kootenay power company is now producing 100,000 horse-power for use in the reduction of the complex ores of the Kootenay country.

The zinc plant now has a capacity of 200 tons daily instead of 100 tons, and this expansion has meant the construction of a great building, which, topped by a 400-foot stack, is a prominent feature of the Tadanac landscape. The completion of the new plant will mean that all the concentrates from the Sullivan mine at Kimberley will be treated at Tadanac.

Electric Furnaces for Metallurgy

SOME interesting electric furnaces for metallurgical processes were exhibited at the British Industries Fair at Birmingham by Automatic and Electric Furnaces, Ltd., of Farringdon Road, London. These included a Wild-Barfield automatic hardening furnace, operating on the well-known principle of electro-magnetic indication of the correct quenching moment. It is claimed for this furnace that it enables carbon and low alloy steels to be hardened with the utmost precision by semi-skilled labour, and automatically turns out hardened steel with the maximum toughness and wear-resisting qualities obtainable. The cost of hardening a ton of steel parts in one of these furnaces with current at 1d. per unit is stated to be 26s.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Sand-cast aluminium-manganese alloys. S. Daniels. *J. Ind. Eng. Chem.*, February, 1926, pp. 125–130. The occurrence of a new compound, possibly Mn Si, is the metallographic feature of the series.

High strength brasses. *Metallurgist*, February 26, 1926, pp. 20–21. A summary of recent investigation in respect of ternary and more complicated systems of modified brasses.

ANALYSIS.—Successive potentiometric titration of copper and iron in metallurgical products. T. F. Buehrer and O. E. Schupp. *J. Ind. Eng. Chem.*, February, 1926, pp. 121–124.

The complete analysis of brass. Part V. *Metal Ind. (Lond.)*, February 5, 1926, pp. 125–126. Deals with the estimation of silicon, oxygen, chromium, and includes notes on some unusual constituents.

CORROSION.—Porosity and intensive corrosion experiments on commercial sheet zinc and other materials. U. R. Evans. *J.S.C.I.*, February 12, 1926, pp. 37–44T. Shows that the corrosion of zinc sheet, partly immersed in chloride or sulphate solution, may be of the regional, point, line or edge-point type, all explicable on the differential aeration principle.

ELECTRO-DEPOSITION.—A general survey of chromium plating. E. A. Ollard. *Metal Ind. (Lond.)*, February 12, 1926, pp. 153–155 and February 19, 1926, pp. 173–177.

FURNACES.—The present-day position of electric smelting furnaces for non-ferrous metals. M. Tama. *Z. Metallkunde*, January, 1926, pp. 7–14 (in German). Describes the construction and operation of the various furnace types.

Electric furnace progress in 1925. F. Hodson. *Blast Furnace and Steel Plant*, February, 1926, pp. 66–71 and p. 108.

GENERAL.—High-power metallography. Some recent developments in photomicrography and metallurgical research. F. F. Lucas. *J. Franklin Inst.*, February, 1926, pp. 177–216. An illustrated article dealing mainly with the process of decomposition of austenite to pearlite in a 0·5 per cent. plain carbon steel.

Metal working and its technical-scientific development in recent years. Part I. J. Czochralski. *Z. Metallkunde*, January, 1926, pp. 1–6 (in German). This paper is mostly concerned with copper.

IRON AND STEEL.—The qualitative and economic importance of acid electric steel. A. Müller-Hauff. *Stahl u. Eisen*, February 17, 1926, pp. 213–218 (in German). Discusses the influence of the acid electric furnace treatment on the structure of steel and compares the products with various basic steels.

The pickling of iron with hydrochloric and sulphuric acids. H. Bablik. *Stahl u. Eisen*, February 18, 1926, pp. 218–222 (in German).

Hard spots on steel forgings. J. D. Gat. *Blast Furnace and Steel Plant*, February, 1926, pp. 74–78. A summary of careful investigation of the phenomena connected with these formations.

Some physical properties of steel and their determination. J. H. Andrew, M. S. Fisher and J. M. Robertson. *Roy. Soc. Proc.*, February, 1926, pp. 391–422. An investigation of the electrode potential, electric resistance and change of resistance during tempering.

A rational study of tempering liquids. J. Hébert. *La Technique Moderne*, February 1, 1926, pp. 65–71 (in French). A summary of the author's researches and practical conclusions in respect of the composition of the baths and the intensity of the treatment.

MAGNESIUM.—Magnesium and its alloys. Part II. S. L. Archbutt. *Metallurgist*, February 26, 1926, pp. 26–30. Summarises in this paper the physical and mechanical properties of the alloys.

ZINC.—Oxidation of zinc vapour by carbon dioxide. B. M. O'Harra. *Chem. News*, February 26, 1926, pp. 138–141. An inquiry into the undesirable formation of blue powder in all pyro-metallurgical processes for treating zinc ores.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered February 5, £24,300 "C" debentures, part of £500,000; general charge. *£1,204,148. November 18, 1925.

ASKERN COAL AND IRON CO., LTD., London, E.C.—Registered January 22, debenture to bank, securing all moneys due or to become due to the bank, over and above £500,000 owing on debenture stock secured by trust deeds dated October 10, 1919, and April 29, 1920; general charge, ranking next after said debenture stock. *£470,272. May 14, 1925.

DORMAN LONG AND CO., LTD., Middlesbrough, steel manufacturers.—Registered February 9, order of Court dated February 4, 1926, amending particulars of trust deed dated July 26, 1923, securing £3,500,000 first redeemable debenture stock by adding the words "and such further sums not exceeding one-half of the nominal and paid up capital of the company from time to time."

DORMAN LONG AND CO., LTD., Middlesbrough, steel manufacturers.—Registered February 11, £500,000 5½ per cent. first redeemable debenture stock, part of amount already registered; charged on property, charged by trust deed dated July 26, 1923. *£3,857,800. December 29, 1925.

GALLOWAYS, LTD., Manchester, ironfounders.—Registered January 5, trust deed dated December 15, 1925 (supplemental to trust deed dated August 5, 1899), securing an increase in rate of interest on £150,000 first debenture stock); general charge (except uncalled capital). *£150,000. December 31, 1924.

GALLOWAYS, LTD., Manchester, ironfounders.—Registered January 20, first charge, to W. Bolton, 42, King Street West, Manchester, C.A., securing debts and liabilities incurred by him or his predecessor as receiver and manager, prior to his discharge; general charge. *£150,000. December 31, 1924.

Satisfaction

FRODINGHAM IRON AND STEEL CO., LTD.—Satisfactions registered February 16, £40,000, part of amount registered October 12, 1917; and £7,495, part of amount registered June 20, 1925.

London Gazette, &c.

Company Winding Up Voluntarily

UNIVERSAL TIN CORPORATION, LTD.—F. Morse, 1 and 2, Great Winchester Street, London, E.C.2, appointed liquidator, February 15.

Weir Steel Houses

THE negotiations between the various parties concerned with the building of steel houses of the Weir type were continued on Wednesday, when the Secretary for Scotland, Sir John Gilmour, presided at a joint conference between representatives of building trade operatives and Lord Weir. It is understood that Lord Weir offered to pay building trade rates of wages to men engaged in digging out foundations for the new houses, but urged that as the joinery and electrical work involved in their construction was so standardised that it could be done by unskilled labourers, these ought not to be paid the same rate as the skilled men elsewhere.

In a debate in the House of Commons on a supplementary estimate for the Scottish Board of Health, which included £200,000 for advances towards the erection of steel houses, Major Elliot stated that it was because of the impossibility of the building trade delivering the goods that the Government claimed general assent to the employment of alternative building methods.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business, should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Beryllium: Its Sources, Production, and Properties

By L. P. Sidney

From recent research it appears that beryllium may be of great value in the preparation of light alloys. Our contributor gives below an account of the present state of our knowledge of the metal.

BERYLLIUM has hitherto been regarded as one of the rare elements, but within the last few years it has been prepared in quantities sufficient for its physical, chemical, and mechanical properties to be studied more adequately than in the past, and it is now attracting considerable attention. It is believed to possess the highest tensile strength of any known metal, and it is this property which makes it of such interest, for in view of its lightness it is hoped that methods will be found to alloy it with some of the other light metals, and to confer upon them some, at least, of the strength and tenacity, in which, for the most part, they are, when pure, somewhat deficient.

Sources and Occurrence

Beryllium occurs in nature chiefly in association with aluminium and silicon, in a number of minerals, and, according to Vogt[1] constitutes from 0·001 to 0·01 per cent. of the earth's crust, although on what computation this estimate is based it is not easy to ascertain. The minerals which contain it are widely distributed and, although not perhaps plentiful, are readily available in amounts sufficient to allow of the extraction of the metal on a fairly large scale. Its low atomic weight and specific gravity render the amount present in what may be termed its potential ores exceedingly small, so that large amounts of material would have to be handled to obtain comparatively small amounts of the metal. Moreover, some of the minerals possess an intrinsic value, owing to their beauty, which would be higher than any which could accrue from the amount of beryllium they actually contain.

TABLE I.

BERYLLIUM MINERALS.

Mineral.	Formula.	BeO per cent.	Where found.
Beryl	3 BeO, Al_2O_3, 6SiO_2	11·0	Brazil, United States, France, Kashmir, Russia, Norway, Madagascar and Colombia.
Chrysoberyl	BeO, Al_2O_3	19·0	Brazil, Ceylon, Russia, United States.
Phenacite	Be_2SiO_4	44·5	Brazil, United States, Russia, France, Switzerland, Mexico and Cornwall.
Enclase	2BeO, Al_2O_3, 2SiO_2, H_2O	17·0	Brazil, Austria, Russia.
Hambergite	4BeO, B_2O_3, H_2O	53·5	Madagascar, Kashmir.

Minerals Containing Beryllium

The most plentiful source of beryllium, up to the present, are the beryls, of which the most familiar varieties are the emerald, and aquamarine, which are alumino-silicates of beryllium, chrysoberyl, which is an aluminate and comprises the varieties known to jewellers as cat's-eye, and oriental chrysolite. The richest beryllium-containing mineral is hambergite, a hydrated beryllium borate. The minerals of beryllium occur for the most part in granitic rocks, of which many of them appear to be decomposition products. They also occur frequently in association with pegmatite. Cahen and Wooton[2] enumerate seventeen species of minerals comprising twenty-five varieties, into the composition of which beryllium enters, besides three others in which small proportions occur. In Table I may be found the composition, formulæ and distribution of the most important, compiled from various sources.

For all practical purposes the most commonly and widely distributed beryllium mineral is beryl, but the percentage of beryllium it contains is only about 4·0. The richer minerals, amongst which may be mentioned bertrandite (2 BeO, 2 SiO_2, H_2O), which is found, amongst other places, in Cornwall, and contains over 40 per cent. of BeO (equivalent to about 13 per cent. of Be), are scarce. It must, moreover, be remembered that the minerals themselves are associated with large quantities of other, mostly valueless, constituents in the rocks in which they occur. In spite of the saying that the streets of Limoges (France) are paved with emeralds the commercial sources of the element are not abundant, although very large individual specimens of beryl have been found in America. According to Parsons,[3] hexagonal prisms weighing over a ton have been found in Grafton, New Hampshire, and one instance is given of a barrel-shaped hexagonal prism weighing 2,900 lb. Small amounts of beryllium-bearing minerals have been found at Braemar and Cairngorm, in Scotland, and extensive deposits are said to occur in the East Indies, and in Burma.

Costs of Production

The following interesting table showing the estimated cost of the chemicals necessary for preparing a gramme of BeO, is quoted by Hopkins[4] from a thesis presented by I. E. Cooper, to the University of Illinois, in 1920.

TABLE II.

COMPARATIVE METHODS OF EXTRACTING BERYLLIUM.

Process.	Yield per cent.	Purity.	Cost of chemicals per gramme of BeO. $
Gibson	77·5	Impure	0.41
Lebeau	50	Very impure	0.16
Pollok	40	Very pure	0.19 to 0.22
Parsons	20 to 40	Very pure	0.06 to 0.08
Copaux	35	Pure	0.26

The Lebeau process is described as long and troublesome.

The results were obtained, by laboratory methods, on 50-gramme samples, and must be regarded as very approximate, as recent developments both at home and abroad give indications that the cost can be greatly reduced. Hopkins remarks that with a 90 per cent. efficiency of production a ton of beryl would yield 80 lb. of beryllium. Elsewhere[5] he states that, in 1919, a 10 to 12 per cent. product (beryl) could be sold at 3 to 4 cents per pound, wholesale, at the mines. As the extraction previously referred to related to a 14 per cent. beryl, this is some 15 per cent. lower, and the yield would only be about 65 lb. These figures suggest that taking the cost of the raw oxides at about £15 per ton, and allowing for a less efficient yield in pure oxide, the latter could be obtained at about £17 10s. per ton, to which various labour and other costs would have to be added. The con-

[1] *Transactions of the American Institute of Mining Engineers*, Vol. 31, 1902, p. 128.
[2] *The Mineralogy of the Rarer Metals*, Second Edition, 1920, p. 16.
[3] *The Chemistry and Literature of Beryllium*, 1908.
[4] *Chemistry of the Rarer Elements, Boston*, 1923, p. 86.
[5] *Op. cit.*, p. 84.

version of the oxide to double fluorides for electrolysis would likewise be costly, and the energy consumption in the subsequent reduction and refining of the metal itself, would appear to render it impossible to produce the latter at a cost of much less than £1 per lb., in existing circumstances. These figures are, however, purely speculative at present. In practice the cost, by processes which have been actually carried out abroad, is far higher, and may be estimated at three or four pounds per ounce.

Recent Developments

The present cost of producing pure beryllium may be regarded as a temporary phase. It must be remembered that it has hitherto been merely a chemical curiosity. Its price, before the war, was £85 per ounce; it has since been quoted on the continent at about £15 per ounce, and most of the authorities on the subject concur in the view that even this is an entirely artificial price. C. Matignon,[6] while of the opinion that it will always be an expensive metal, does not think that that expense will debar it from being used in certain connections, as an alloy metal. It may be recalled that, according to Anderson,[7] the price of aluminium, in the early days of that metal, fell from $545 per pound, to $11.33, in the short period of eight years, consequent on improved processes of production due to increased demand. Magnesium is another metal which has become enormously reduced in price within the last few years, and is becoming cheaper every day.

Investigations in Progress

The metal is being investigated in America, both under the auspices of the Bureau of Standards, and in the laboratories of the Naval and War Departments. In France it has been studied by Portevin, and by Matignon. The late Dr. Hans Goldschmidt and the company with which he was connected have subsidised investigations in Germany, where a new and successful process for the production of beryllium was recently announced. Since his death Messrs. Siemens and Halske have been carrying on further researches, the direction of which has been in the hands of Professor Stock. It was this scientist who, it is claimed, was the first to produce chemically pure beryllium in compact and coherent metallic masses, all previous reductions having been either contaminated with other impurities, and, in particular, with iron, calcium and aluminium, or in the form of globules which it was almost impossible to get to coalesce, owing to the oxide films which form at the temperatures of reduction.

It is satisfactory to learn that investigations are likewise being carried out at the National Physical Laboratory, under the superintendence of Dr. Rosenhain. Pure beryllium has been obtained at the Laboratory in quantities sufficient to allow of its physical properties being very thoroughly examined, and it is understood that some of the results will be published shortly. These particulars will, it is to be hoped, settle some of the controversial points respecting the metal, and throw some light on the actual specific gravity which should be assigned to the pure metal. The estimates at present to be found in the literature range from 1·62 to 2·13. This raises the question of whether beryllium is lighter or heavier than magnesium, the specific gravity of which is usually taken to be 1·72. The latest determinations in regard to beryllium lead to the assumption that its specific gravity is 1·8.

History of the Metal

Dr. Mellor, in his admirable and exhaustive Treatise on Inorganic Chemistry,[8] deals at considerable length with the history of the metal and those interested therein cannot do better than consult that most interesting work. Its existence was first recognised by Vauquelin who, at the instance of Haüy, the father of modern crystallography, discovered the difference between alumina and beryllia (BeO), and published an account of his investigations in the *Annales de Chemie*. Wöhler is credited with having been the first actually to prepare the metal, by reducing the chloride with potassium somewhere about 1797. There is every reason to assume that the dark grey metallic powder he obtained was very impure. The pure metal was probably first produced by Stock, as already mentioned, in 1921.

[6] *Chemie et Industrie*, Vol. 15, January, 1926, p. 1.
[7] *Metallurgy of Aluminium*, New York, 1925, p. 7.
[8] Vol. IV., Longmans and Co.

Processes of Reduction

Table II (on previous page) gives the comparative methods of extracting beryllium:

The processes referred to are, briefly, as follows:—

Gibson process.—Reduction of beryl by ammonium hydrogen fluoride, to mixed fluorides of beryllium and aluminium.

Lebeau process.—Conversion of the beryl to sulphate, and separation of beryllium by ammonium carbonate.

Parson's process.—Fusion of beryl with potassium hydrate, and removal of alumina as alum, by solution. The *Pollok process* is similar.

Copaux process.—Fusion of beryl with sodium fluosilicate, and subsequent conversion into sulphate.

These processes are only of a preliminary nature. The actual reduction is usually effected either by heating with potassium or sodium, or by electrolysis of the fused salts, preferably mixed with the corresponding sodium or potassium fluorides. The electrolysis of cold solutions of beryllium salts is unsatisfactory as the resulting flocculent deposits are intractable. The Copaux system, in conjunction with electrolysis of the molten sulphates by Lebeau's method, has been successfully employed in France, the small crystals of beryllium being subsequently fused in an induction furnace, *in vacuo*, to form coherent masses. In Germany the Goldschmidt process is employed. A graphite crucible serves as an anode, the cathode being a water-cooled iron tube. A bath of mixed sodium and beryllium fluorides, maintained at a temperature of 1,350°, is used, and with a current of 50 amperes and 80 volts, about 50 grammes of beryllium, slightly contaminated with iron from the cathode, can be obtained as the result of a nine hours run. An improved process in a high frequency furnace is employed at the National Physical Laboratory, and a purer product obtained.

Properties of the Metal

Beryllium is a steely-blue metal with a finely crystallised blackish-grey fracture. As prepared in accordance with the latest methods it appears compact and free from porosity. Its hardness is in the vicinity of 150 Brinell, and it scratches glass easily. It is capable of taking and preserving a high polish and is practically unaffected by atmospheric influences, although in the vicinity of its melting point, which is 1,278° C., it oxidises rapidly. It volatilises at 1,530°, under pressure, and has the highest latent heat of fusion of any known metal (0·62). The crystals produced when the metal is deposited by electrolysis of its fused fluorides are hexagonal, and the X-ray structure resembles that of magnesium. Its specific gravity is probably 1·8, or rather higher than that of magnesium, and its atomic weight is taken to be 9·1. In some of the processes for the electrolytic reduction of beryllium great difficulty is experienced in getting the globules to coalesce owing to the persistent film of oxide which clings to them. The principal impurities associated with reduced beryllium are carbide, aluminium, iron, and calcium, and unless these elements are absent in the mixed molten salts, they are very difficult to get rid of in the subsequent refining operations. The carbide is of course derived from the graphite crucibles in which reduction is effected.

Uses of Beryllium

The high melting point of pure beryllium militates against its alloying with magnesium, as the latter boils at 140° lower than the melting point of beryllium. The difficulty of obtaining an alloy of the two metals is therefore great, although not necessarily insuperable, provided an intermediate carrier can be discovered. This is regrettable, for it is precisely in connection with magnesium that beryllium might be expected to yield very promising results. Magnesium is deficient in tensile strength; beryllium has the highest modulus of any pure metal. The following list shows how it compares in this respect:—

	Modulus of elasticity. Kilogrammes per sq. mm.
Magnesium	4,000 to 5,000
Aluminium	7,000
Zinc	9,000
Steel	20,000 to 24,000
Nickel	22,000
Rhodium	28,000
Beryllium	30,000

An alloy of beryllium and aluminium is the subject of an American patent.[9] It consists of 90 per cent. aluminium and 10 per cent. beryllium, and has a specific gravity of 2·5 and a high tensile strength. An alloy of lithium and beryllium (Li 25 per cent.) is said to have remarkable properties. The cupro-beryllium alloys have very high electrical conductivities and are said to possess peculiar acoustical properties which make them of value in bells, and in musical instruments. Numerous other alloys of beryllium have been described, while the uses of the oxide (BeO), beryllia, are numerous both as a refractory and as an abrasive. Within the limits of the present article it is quite impossible even to enumerate the many applications of beryllia. Enough has, however, been said to show that both the metal and its compounds merit the increasing attention which is being paid to them.

Electrical Resistance Furnaces

Electrical resistance furnaces have assumed growing importance scientifically and industrially. Below we publish an abstract of a lecture on the subject delivered by Mr. W. B. Clements before the Northern Polytechnic Chemical Association.

THE production of heat electrically has been largely developed during the last few years, one of the most important developments being the electric furnace, which is finding a growing application in the scientific laboratory and in industrial processes. Furnaces heated by fuel of any kind give off products which must be allowed to escape up a flue, resulting in a large loss of heat. In the electric resistance furnace, no products of combustion are formed, which is a great advantage. The complete electrically wound chamber is enclosed in a lagged housing, so that the heat lost is reduced to a minimum, quite 90 per cent. of the heat developed being utilised to heat the furnace chamber. This fact permits small furnaces to be heated very economically by electricity. A further point in the favour of electrical furnaces is the ease and precision of temperature control.

Definite temperature conditions, rate of heating or cooling, can be reproduced with accuracy, and these points are often essential to the complete success of laboratory and industrial operations. Moreover, these conditions are easily obtained, no complicated control gear being necessary. All that is required is a suitable regulating resistance in series with the furnaces, and a pyrometer to indicate the temperature in the furnace chamber. The efficient lagging possible only with electrical furnaces (there being no products of combustion) enable these to be used anywhere. The small loss of heat does not unduly heat the atmosphere of the room.

Design of Furnaces

In electric furnace design our problem is to develop heat, and as we desire a large rise in temperature, it is therefore necessary to increase the resistance of the current-carrying wire used in our furnaces, and this of course means the use of a material with a large specific resistance. Also it must be able to withstand high temperatures for long periods, without deterioration. Platinum was used as the heating element in the first form of resistance furnace made by Heraeus in 1902. The drawback to the use of platinum, apart from its high cost, is its increase in resistance with temperature rise. Moreover the present high cost of platinum, about 500 shillings per oz., makes its use impossible except for special cases. Pure nickel was tried. It gave quite useful service for temperatures up to 900° C., and, for short periods, up to 1,000° C. While, like platinum, it had a high temperature coefficient of resistance, it had the advantage of being comparatively cheap, so that when a " burn out " occurred, the winding could be renewed at low cost. In 1907 nickel-chromium alloy (nichrome) was introduced in the form of wires and strip, and proved to be very valuable for electric furnace windings, and for electric heating elements generally, and at the present time it is the only alloy in use for this purpose. The best composition for the alloy is 80 per cent. nickel and 20 per cent. chromium. This resists oxidation more vigorously than any other base metal combination, and will stand running at 1,100° for long periods without breaking down.

In the majority of the nichrome resistance furnaces the wire or strip is wound directly on the outside of the tube, crucible or muffle, and held in position either by being wound in slots or grooves or cemented over with a suitable refractory cement. Various factors affect the life or durability of any heating element or winding. The temperature at which it is to be operated should not exceed 1,100° C. Under these conditions a life of 1,000 hours is to be expected. Running the furnace at 1,200° C. gives a maximum life of 50 to 60 hours. The conditions of service must be considered—that is, continuous or intermittent operation, steady or fluctuating line voltage, and atmospheric conditions surrounding the winding material in contact with the nichrome. Continuous operation gives longer life per element than intermittent use, probably due to the fact that in the former case the wire is not subjected to the expansion and contraction which occur each time it is switched on circuit in intermittent use. Covering the wire with refractory cement prevents the atmospheric oxygen from oxidising the nichrome. At high temperatures metals may change in structure, and on this account the nickel may become brittle. The great development attained by resistance metal-wound furnaces is certainly due to the introduction of nickel-chromium alloys, and at the present time numerous types of nichrome-wound furnaces are on the market. Tube furnaces are made in a number of sizes and can be used for purposes such as the determination of the critical points of steel, demagnetising iron or steel rods prior to performing tests for saturation, annealing specimens of metals for microscopic examination, the determination of the carbon content of steel, etc. Muffle furnaces are very useful in the metallurgical laboratory for annealing metals, and in the workshop for the hardening of carbon steel articles, such as dies, punches, gauges, and small work generally. Crucible furnaces are also made, and may be used for the melting of metals up to 1,000° and similar purposes.

Very High Temperatures

For temperatures up to 1,000° C. or at the outside limit 1,100° C. nichrome-wound furnaces have been proved satisfactory, but for temperatures above 1,100° C. up to 1,800° C. a furnace to fulfil the requirements of general research and laboratory work is not yet available. Furnaces have been wound with molybdenum or tungsten. These metals have a very high melting point, 2,550° C. for the former and 3,200° C. for the latter, but unfortunately they oxidise rapidly in air, and the furnaces have to be so designed that an atmosphere of hydrogen can be maintained throughout the furnace. This drawback has proved a deterrent to their general use.

Many furnaces have been designed in which the resistance material is carbon. Carbon will withstand very high temperatures, but it commences to oxidise in air at 600° C. and this becomes very rapid at higher temperatures. Furnaces using carbon must therefore be designed so that provision is made to prevent oxidation, or so made that the carbon resister is easily renewable. Various types of furnaces using carbon have been made. In one type carbon forms the heating chamber, tube or crucible, and current at very low voltage and very high amperage is passed directly through the furnace chamber, connection being made to the electric supply by means of cooled water holders. Special transformers are required for connecting the furnaces to ordinary A.C. mains. Temperatures up to 2,500° C. have been obtained in this type, but the carbon furnace chamber requires very frequent renewing.

The best furnace of the carbon type is one in which the furnace chamber is heated by carbon rods, plates or strips, connected in series, through which the current flows. This type offers the greatest possibility of development, its chief disadvantage being the short life of the carbon rods or plates, but providing these can be produced cheaply, and the furnace designed so that they can be easily and quickly renewed, this should not prove a very serious drawback. Recently silit (a form of silicon carbide) rods have been used and have proved more successful than ordinary carbon or graphite rods. When further developed the carbon type of furnace should prove very useful for the heat treatment of high speed steels.

[9] U.S. patents, 1,333,965, March 16, 1920.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Gas for Heat Treatment Purposes

THE utilisation of gaseous, in lieu of solid fuels, for the heat treatment of metals and for other industrial purposes has made remarkable progress during the present century, and probably in no other town do such facilities exist for acquiring a knowledge of the economical and technical advantages of gas for furnace work as in Birmingham. For this reason, the striking figures which have lately been given by Mr. A. W. Smith, the general manager of the Birmingham Corporation Gas Department, are of particular interest to those associated with metallurgical processes. After telling of the work of its industrial gas section since it was founded in 1909, Mr. Smith spoke of the extension of that section known as the Industrial Research Laboratories, which includes in its activities advisory work in connection with the installation and repair of any make or type of gas-heated furnace, physical testing work on a large scale, chemical investigations, analyses of steels and a special heat treatment section through which large quantities of work pass weekly for heat treatment on a full practical scale.

Recuperative Furnaces

THE city's gas supply is maintained as nearly as possible at a pressure approximating 20/10ths to 30/10ths inches water column, and it may be of interest to mention that about 30 per cent. of the industrial load is obtained from gas used in muffle and oven furnaces of the natural draught type, for such purposes as annealing, carburising, reheating, tempering and hardening, where the maximum temperature required does not exceed 950° C. A large number of furnaces of this type will undoubtedly be replaced by more modern types employing full recuperation, with the result that the working efficiencies will be increased. The employment of more efficient types of furnaces will to a great extent be decided by the extent to which trade conditions will allow of continuity of operation, as, for intermittent working, the most efficient forms of recuperators cannot be employed, owing to the time required in heating up the settings to a working temperature.

For obtaining high temperatures in small spaces, or where a very high rate of working is required, low pressure gas, injected by means of air under pressures of from ½ to 2 lb. per square inch, is used, and in some cases air-gas mixing systems are adopted. The city is also fortunate in having upwards of 30 miles of mains carrying gas at a pressure of 11½ to 15 lb. per square inch, and many industrial consumers are given supplies of high pressure gas direct from these mains for furnace work. The remarkable increase of business which has accrued from the enterprising policy of the Gas Department at Birmingham is illustrated by the fact that whereas in 1911 the sale of gas for industrial heating purposes was 389 million cubic feet, in 1925 it amounted to no less than 2,300 million cubic feet.

America's Metallurgical Coke Record

ACCORDING to an American contemporary the total production of coke in 1925 was a trifle less than in the two war years 1917 and 1918, and only about equal to 1920, but the output was notable because more than ever before in history came from by-product ovens. Approximately 57,500,000 tons of coal were carbonised in the by-product ovens during the year, with a production of approximately 40,000,000 tons of by-product coke and corresponding quantities of by-products. The average monthly production of by-product coke in 1925 was, in fact, the greatest in history. Furthermore, the production continued throughout the year with but little variation. Most of the changes in coke demand were made by changes in the rate of production of beehive coke. During the summer months, where there was somewhat lessened demand for coke, the output from beehive ovens was only about 40 per cent. of that during December. It is evident from these facts that the beehive ovens are now serving almost exclusively as a mere balance in the industry, affording increased or lessened output as demanded. This information as to the situation of the beehive producers in America should be an instructive example to coke producers in this country, for it illustrates in no unmistakable manner how the old wasteful process has been almost entirely superseded by modern by-product recovery plant.

Traditions of the Non-Ferrous Trades

THE non-ferrous metal trades have always been somewhat secretive in the matter of publishing particulars as to methods and processes—more so, in any case, than the so-called "heavy trades." The good work of the Iron and Steel Institute, which was founded in 1869, is, to a considerable extent, responsible for having broken down much of the reserve and suspicion with which the technical departments of iron and steel works regarded each other in the middle "'eighties." Even Sheffield, traditionally the Lhasa of the steel trade, surrendered to the blandishments of the Institute, and the meeting in that city in 1905 marked, perhaps, the zenith of its achievements. Many works, whose sacred portals had never before been desecrated by the foot of the stranger, threw open their shops and displayed their processes with an unwonted frankness and hospitality. It may be that there were reservations, mental and other, but on the whole the spirit displayed on that occasion was not only generous but wise. The Institute of Metals appears to be still further developing the traditions of free and open discussion, and the non-ferrous industries of this country have all to gain, and little worth having, to lose, by following its lead. Several of the papers read at the recent annual meeting confer hardly less credit on the firms which sanctioned their publication than upon the authors who prepared and read them.

Die Casting of Aluminium Alloys

THIS is particularly noticeable in regard to the paper on "The Die Casting of Aluminium Alloys," by Mr. George Mortimer, to which the place of honour was accorded at the meeting. The paper is one which it is difficult to overrate. It deals exhaustively with the technique of die casting and contains hints and details which cannot fail to be of the utmost value to those who have to deal with light alloys of this nature. It would, perhaps, have been even more highly valued had it dealt with the actual composition of the alloys to a greater extent. The paper, however, was an excellent one as it was. That it was appreciated was shown by the discussion it elicited. One of the speakers suggested the use of nitrogen in making pressure castings. It is an interesting suggestion, but one which might be liable to do more harm than good. Aluminium at temperatures not very much higher than its melting point is prone to combine with nitrogen, and the resulting nitride is a very objectionable contamination. Both Richards and, more recently, Richarz have pointed this out, while Tschischewski states that the reaction occurs as low as 400° C. A very appropriate contribution to the discussion was made by Dr. Rosenhain, who lodged a well-founded objection to what he termed the indiscriminate use of the term "die casting." It is one that is employed far too loosely; it can even be applied to any ordinary open-mould casting. It is time the term were confined to one particular kind of casting, and that founders should make up their mind as to what sort of a casting it should be.

Light Metals and Electricity

THE connection between light metals and electricity is not far to seek. Aluminium and magnesium are both produced by electrolysis; beryllium is produced by similar means. The former metal is an excellent conductor, and magnesium is almost as good. Aluminium cables and aluminium covered cables are increasingly employed for overhead distributing systems abroad, where very high tensions are habitually transmitted. France and Southern Germany are rapidly building up a first-class industry in the production of metals by electro-chemical methods. It would appear that we, in this country, are to wait for another fourteen years before electrical energy is cheap enough and plentiful enough for it to be applied, economically, to these very important uses!

It is by no means certain that, even in 1940, we shall be as happily equipped with the needful current. Nor, on the other hand, is it by any means certain that we should need to wait so long. The Report of the Coal Commission has had what is known as a good Press; but the Electricity Bill has fallen flat. This is because of its peculiar nature. It is, at present, only an "empowering Bill." It confers on a body

yet to be created powers yet to be defined. There have been a number of annual meetings of various Electric Supply Companies held during the past week and in no single case has any good been said of the prospective measure. It may conceivably be a very potent means of harm; it cannot, at best, do more for the country than the country can, if left alone, do for itself. The prospect of electricity at 1d. per unit in 1940, as compared with existing supplies in 1926, at well under that figure, is not very exciting. Cheap electricity, cheaper than it is at present, is a vital necessity for an electro-metallurgical industry. The ores of the light metals are cheap and abundant; bauxite and magnesite are inexpensive and abundant. Will the empowering Bill help us in regard to metallurgical processes for the production of these metals? Those who know best see in it a hindrance to industry rather than a help.

Cadmium Plating

MANY of the vexed questions relating to the corrosion of the common metals would be solved if any really durable protective coating could be discovered. Tin and zinc do fairly well, within their limitations, but once a metal coating like tinning or galvanising breaks down the last state is worse than the first. Less is heard nowadays of the Schoop process; sherardising gives fairly satisfactory results; chromium plating is progressing rapidly and is in great favour in America. Cadmium has been used as a coating for iron for some time past, but has hardly done more than pass the experimental stage. As an industrial process on a large scale it has not, as yet, achieved unqualified success. There is also a good deal of prejudice in regard to cadmium as a plating metal. Confused views as to its electric potential and its true position relative to iron prevail. Some interesting work designed to ascertain the true electrode potential of cadmium and its place in relation to zinc and iron has been carried out by H. S. Rawdon, of the Bureau of Standards, Washington, and is to be discussed in a paper to be presented, on the 26th of this month, at the Chicago meeting of the American Electro-Chemical Society. The results will be awaited with interest. In the meantime it should not be forgotten that we have, at home, a very live and energetic society of our own. The newly established Electroplaters' and Depositors' Society, which meets at the Northampton Polytechnic Institute, is making substantial progress. The subject of the next meeting is a paper by Mr. J. S. Sunderland, on "Heavy and Rapid Copper Deposition," which will be read on the 14th inst.

Ancient Implements and Modern Research

SOME interesting results have recently been obtained by Professor C. O. Bannister by the examination of ancient metal implements. An article on the "Examination of Bronze Implements," by C. O. Bannister and J. A. Newcomb (*Nature*, November 28, 1925), deals with the investigation of a chisel and a palstave of the Bronze Age. Analysis of the implements showed for the chisel, copper 85·5 per cent., tin 14·2 per cent., and for the palstave, copper 86·9 per cent. and tin 12·7 per cent. Microscopic examination of the chisel indicated that, when made, the metal cooled quickly in the mould. The important point, however, was that the bronze in the chisel showed the well-known dendritic or core structure. The view has been held in some quarters that, during the course of a long time, even at ordinary atmospheric temperatures, diffusion would proceed in solid alloys, with the result that equilibrium would eventually be obtained exactly as may be obtained at higher temperatures in a few hours. The dendritic structure of the chisel was so typical of recently cast bronze that it seems that no diffusion had taken place during the ages. In connection with the examination of the palstave, the authors point out that it has been suggested that if an antique metal had been worked or strained, crystals may form at ordinary temperatures, during the ages, similar to those that would be formed in a short time if the metal were heated. Examination of the palstave indicated that this was not so in the case of bronze. The presence of corrosion products in the boundaries of the crystals indicated that the crystals must have been in existence before corrosion commenced.

A further development of this line of research is indicated by Prof. Bannister in a "Note on the Corrosion of an Ancient Tin Specimen," read at the Annual General Meeting of the Institute of Metals. This note contained the results of the examination of an ancient tin sheath, the metal portion of which contained 99·98 per cent. tin. The metal was covered with a corrosion product which contained 76·82 per cent. tin and 5·1 per cent. combined water. On driving off this water by heating in air the product showed a loss of only 0·59 per cent. indicating that it had gained 4·51 per cent. oxygen. These results show that the product contained hydrated stannous oxide 43·35 per cent. and anhydrous stannic oxide 54·68 per cent. The mechanism of corrosion of metallic tin therefore comprises the formation of hydrated stannous oxide and subsequent oxidation and dehydration.

U.S.A. Aluminium Production in 1925

THE value of new aluminium produced in the United States during 1925 was $36,430,000, a decrease of a little over 3 per cent. as compared with 1924, according to information furnished by Mr. J. M. Hill, of the Bureau of Mines. The decrease was in part attributable to the drought in the Eastern States, which caused the shutting down of two plants for some weeks. Virgin aluminium of 99 per cent. grade was quoted at 28 cents per lb., and the 98 per cent. grade at 27 cents until the end of October, when an advance of 1 cent was made in each grade. The price was reduced to 28 cents and 27 cents in the first week of 1926. Aluminium bronze powder was used in in increasing amounts for oil tank and interior shop painting, because of its high reflective and protective properties. Aluminium furniture was developed during 1925. The electrical industry still consumes large quantities of the metal, but the automobile industry remains the largest consuming industry.

Imports of aluminium metal, scrap and alloy in 1925 increased nearly 48 per cent. as compared with 1924, reaching a total of 43,409,546 lb., valued at $10,180,497, in 1925. Imports of plates, sheets and bars on the other hand decreased 87 per cent., amounting to only 102,338 lb., valued at $47,740, in 1925. Exports of aluminium ingots, scrap and alloys in 1925 were 8,130,222 lb., valued at $1,835,213, an increase of 142 per cent. as compared with exports in 1924. Exports of plates, sheets, bars, etc., in 1925 were over 50 per cent. greater than the quantity sent abroad in 1924, but tubes, mouldings, castings, and table and other manufactured ware were exported in about equal amounts in 1924 and 1925. The total exports of aluminium in 1925 were 19,105,226 lb., valued at $6,057,071.

New Electric Resistance Furnace

A TYPE of electric furnace suitable for some metallurgical purposes, in which the resistor is a plain carbon tube mounted vertically in water-cooled electrodes, has been described recently by A. G. Lobley and D. Jepson. The furnace is so arranged that work can be carried out *in vacuo* or in an atmosphere of any desired gas. By means of this apparatus the authors have examined the effect of heating copper to temperatures between its melting and boiling points in atmospheres of nitrogen, hydrogen, and carbon monoxide. The molten metal does not absorb nitrogen and carbon monoxide in excess of that soluble in the solid metal at temperatures of 1900° C. and 1700° C. respectively. Hydrogen is absorbed at temperatures up to 2200° C., the excess beyond that soluble in the solid metal being ejected, with blowhole formation, on solidification. The Brinell numbers do not vary with either temperature or the nature of the gas used.

Tests at High Temperature

As part of the investigation of the mechanical properties of several ferrous and non-ferrous materials at high temperatures, the results of the examination of a nickel-copper alloy (70 : 30) containing 2·35 per cent. of manganese have been discussed by H. J. Tapsell and J. Bradley in a communication to the Institute of Metals. Mechanical tests—comprising tensile, torsion, impact, impact hardness, "fatigue" under reversed stresses, and "creep"—were carried out on the alloy at temperatures between atmospheric and 700° C. to 800° C. Limiting creep stresses were determined between 400° C. and 700° C. There is a large difference between the apparent ultimate strength, as determined by tests made at the ordinary rate of loading, and the safe strength, or ultimate creep stress, obtained from tests made under constant loading conditions over long periods. The results show that a synthetic nickel-copper alloy can be made which will give a satisfactory performance at a high temperature.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

IT is not possible, unfortunately, in reviewing the month of March, to say anything encouraging about the iron and steel trade. The retrograde movement which was in evidence in February has not been reversed; if anything, it is slightly more accentuated. In whatever direction one looks and in every quarter where inquiries are made, the same conditions are observed and the same answer is given. Business is very quiet, orders are scarce, prices are weaker than ever, and the recital is ended by the generally expressed opinion that no improvement can be expected during the year 1926.

There are so many causes to prevent any optimism. There is the uncertainty of the outcome of the coal question, the trouble in the engineering industry, the prospect of increased competition at home by reason of the approaching increase in productive capacity, the unsettled condition of international relations in Europe, particularly the disturbing influence of political and financial conditions in France. When these influences are added to the already deep seated sense of despondency, it is easy to realise why the outlook is cheerless. A prominent steel manufacturer last week was speaking in an optimistic tone of the course of trade, and he based his optimism on the fact that the total production of steel last year in his own district was considerably greater than in 1913. His optimism was a tonic, but the effect did not last long. It was impossible to keep back the thought that a 50 per cent. increase in capacity with only 25 per cent. increase in output could hardly be considered an improvement.

Mr. W. L. Hichens' Forecast

One is bound to take notice of the words of such leaders of industry as the Chairman of Cammell, Laird and Co., Ltd., Mr. W. L. Hichens. He is not generally pessimistic, neither is it his custom to paint things brighter than they actually are. Therefore his words are to be listened to with respect. His forecast of trade during the coming year was not inspiring. He held out no hope that this year would be better than last, but gave it as his frank opinion that it would probably be worse on the whole.

Those who are responsible for carrying on the individual units of the iron and steel industry are shouldering a heavy burden and deserve all praise for their efforts. It is easy to give praise when everything is going well and profits appear month after month, but blame is not to be thoughtlessly laid upon those whose best efforts seem to result only in failure. The causes are outside the power of any one man or firm to alter, and the most efficient administration may fail to produce results on the right side. It is true that in some cases profits are still being made, but these are almost invariably decreasing, and the number of firms who are making losses must far outweigh them. The balance sheets which have appeared so far this year are not encouraging, and we do not expect subsequent ones to be any more so. The low level at which all iron and steel shares stand shows the market opinion of the industry.

Hopes in the Shipbuilding Industry

There may be something in the report—we earnestly hope there is—which has appeared in some of the papers recently to the effect that there is a promise of improvement in the shipbuilding industry. For instance, the orders booked on the Clyde during January and February are said to be larger than in any previous period of the same length. That is not much to go on, but if it shows a tendency it is of great importance. A revival in the shipbuilding industry would mean a great deal to the steel trade. Formerly the steel works on the North East Coast and in Scotland were kept busy mainly on shipbuilding work, and they were not so keen to compete all over the country for the ordinary constructional work. The lack of work in the shipyards has made it necessary for these steel works to cultivate a much wider area, with the result that all parts of the country have been very thoroughly combed out in order to find work to keep these mills in operation, and even now they are operating only part time. Let the shipyards get busy, and these works would turn on to their natural markets, and there would be some check to the fierce competition which is now raging. Within the last few days there has been a meeting of the associated steel makers, and at the time of writing it is rumoured that the decision is to advance the basis price of plates. Whether this is correct or not will be known when this is in print. Certainly such a move would be a wise one. We do not want a big advance at present, but just sufficient to show the consumers that prices have definitely reached bottom, as this will bring out orders which are now being held back.

The Problem of State Aid

The report of the Coal Commission is now public property, together with the decision of the Government to accept the recommendations of the Commission. This does not mean that all difficulties are cleared away and that the threatened crisis is definitely averted, but already there seems to be a more reasoned frame of mind among those whose extreme views have been causing excitement. It is now essential that the problem should be considered reasonably and seriously by the owners and the men along the lines of the Report so as to find the best of the doubtful means of making the most of this national industry. The subsidy is to cease in a few weeks' time, and at present the alternative suggestion from the Government is that loans should be granted to the efficient collieries to enable them to develop the trade to the best advantage. Being steel makers, we are not favourably impressed by this continuance of State aid to one industry. The steel trade needs assistance even more than the coal trade, and it is of almost equal national importance. Seeing that the Government's chief practical aid is financial, it is a pity that the claims of the steel trade were not pushed earlier, as we believe they would have been successful had the coal subsidy not been already granted. We still agree with Sir Hugh Bell's opinion that the only satisfactory basis on which industry can prosper is payment according to the work done, and that it is entirely harmful to encourage men in their demand for money which they have not earned; but as financial aid is being given, let the steel trade have its share, as after all the coal trade cannot be prosperous if the steel trade is languishing. A healthy condition in steel means good trade for the collieries.

International Selling Prices

There has been some interest aroused by the report that an international agreement has been reached to regulate the selling price of steel rails, the countries interested being Great Britain, Germany, France and Belgium. The report is not definitely confirmed. It may be part of the bigger scheme for controlling the whole of the iron and steel production. We do not think this scheme will succeed, although there may be more hope for localised selling organisations in this country which will deal with the products of the various groups of works. It is realised that there is not much left undone in the way of reducing costs and more attention is being turned to the selling side of the industry.

The actual trade conditions during the month have been distinctly quiet in every department. Pig iron is not being sold in any quantity, but most of the makers still have fair quantities to deliver against the contracts made a month or two ago. Steel billets are weaker; and there is a reduction in the prices being quoted by the continental suppliers. Sections and bars show no improvement and very low prices are accepted for good orders. Steel plates are about the worst item, and the price cutting has been as keen as ever, both for ordinary and boiler quality.

The production figures for February show an improvement on January, but any increase in output has been more than offset by the lower prices which have been taken; and those works which are busiest admit that the level of prices is now lower than it ever has been. Pig iron production was 502,000 tons compared with 533,500 tons in January. There were two more furnaces in blast at the end of the month than at the beginning. The production of steel ingots and castings was 703,800 tons compared with 640,400 tons in January, being the largest output in any month since May, 1924, when it was 809,700 tons. The exports of iron and steel were 339,500 tons compared with 336,700 tons in January.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Steel

IN a process for the production of steel from materials including solid produced iron in an open hearth furnace, the iron is protected from oxidation by the addition of other materials such as pig iron or ferro-silicon, which are more oxidisable than the solid produced iron. 15–20 per cent. of pig iron may be used or 5–10 per cent. of ferro-silicon. When using a basic furnace, the bottom is covered with lime, part of the iron is introduced, and then a layer of pig iron. This charge is melted, and the remainder of the charge then added. When using an acid furnace the lime is omitted and the bottom covered with sand. See Patent Applications 245,715–6–7, by C. H. Wills, Detroit, Mich., U.S.A. (assignee of J. K. Smith of Worksop, Notts), having the International Convention date, January 10, 1925.

Sulphide Iron Ores

IN the desulphurisation and concentration of sulphide iron ores the ore is subjected to the action of iron oxide containing at least 50 per cent. SO_2 in a muffle or other furnace such as a mechanical furnace, the lower floors of which are maintained at a temperature up to 950° C. The ore is subjected to a gradually increasing temperature to drive off part of the sulphur leaving FeS, and the remainder of the sulphur is then driven off leaving a highly magnetic porous product suitable for subsequent hydro-metallurgical treatment. See Patent No. 247,471 (W. S. Millar, London), dated August 12, 1925. This patent is an addition to 236,256. See THE CHEMICAL AGE, Vol. XIII, p. 23 (Metallurgical Section).

Lead-tungsten Alloys

ACCORDING to a patent by H. Falkenberg of Weetzen, near Hanover, Germany, a homogeneous alloy of lead and tungsten, which is particularly suitable as a bearing metal, is obtained by melting together metallic tungsten with an equal quantity of an alloy of lead and antimony, with the addition of a small proportion of iron. This is diluted by adding lead-antimony alloy, and finally an alloy of tin, antimony, copper, and lead. Alternatively, the tin alloy can be replaced by an alloy of zinc, lead, and iron. Two examples of such tungsten alloys are: (1) Tungsten 0·02–3 parts, lead 47–80 parts, antimony 15·5–25 parts, copper 0·7–10 parts, tin 0·5–25 parts; (2) Tungsten 0·02–3 parts, iron 1–5 parts, copper 1–2 parts, aluminium 1–3 parts, zinc 86–96 parts, lead 2–5 parts, antimony 0·02 parts. See Patent No. 247,687, dated December 8, 1924.

Uranium

A PATENT application by Westinghouse Lamp Co., of Bloomfield, N.J., U.S.A., describes the preparation of ductile uranium by preparing a double uranium salt as described in specification 230,865 (see THE CHEMICAL AGE, Vol. XII, p. 47, Metallurgical Section), and reducing it with calcium in presence of calcium chloride as described in specification 238,663 (see THE CHEMICAL AGE, Vol. XIII, p. 31, Metallurgical Section). The uranium powder obtained is heated to obtain a ductile mass. See Patent Application No. 246,147, having the International Convention date, January 13, 1925.

Metallic Carbides

ACCORDING to a process by H. Lohmann, of Berlin, solid tungsten or other refractory carbides are obtained by heating the acids, anhydrides, or highly-reduced oxides, or the metals themselves in carbon crucibles with the addition of small quantities of thorium, uranium, tantalum, molybdenum, or like metals. See Patent Application No. 246,487, having the International Convention date, January 24, 1925.

Reducibility of Various Zinc Compounds

AT Mississippi Valley the U.S. Bureau of Mines is endeavouring to determine the cause of the varying reducibility of different zinc ores, and to find some method of quickly measuring the comparative reducibility of ore samples.

Increasing Use of Aluminium

The Value of Research

IN the course of his address at the ordinary general meeting of the British Aluminium Co., Ltd., on Tuesday, the chairman, Lieut.-Colonel S. H. Pollen, said that research was of the highest value to them in the improvement of methods of production. Whilst the prices of raw materials and other charges showed no inclination to decrease—the tendency was rather the reverse—these augmentations were largely counterbalanced this year by increased efficiency in the processes in use. For this they were indebted to the results of research. They were confident that they had by no means reached finality in this direction, and would relax no effort with a view to still further improvements.

The development of non-corroding alloys had led to a marked increase in the use of aluminium in marine construction, and the textile industry was adopting the metal more extensively. Particular interest attached to aluminium alloys road wheels. These wheels had definitely proved thoroughly satisfactory, and led to considerable weight saving, especially in the case of heavy omnibuses and similar vehicles. Some of these wheels had run over 120,000 miles, and they were informed that in no single case had any defect developed in service. The electrical industry augmented its demand for the metal, and the economy arising from the use of aluminium for transmission lines, 'bus-bars, and other applications in the industry became more and more widely appreciated. The new proposal of the Government for the more general distribution of electricity should, if proceeded with, lead to a greater extension of overhead transmission lines, and they hoped the aluminium industry might benefit from this development. The world's annual use of aluminium to-day in tonnage was approaching double the consumption of tin, and the world consumed in greater quantity only three other non-ferrous metals—copper, lead and zinc. The salts of aluminium were more widely and plentifully distributed throughout the earth's surface than those of any other metal, not excepting iron, thus assuring an ample supply of the necessary ores from which the metal was produced.

U.S. Research in Flotation

AN investigation into the rate of flotability of several of the common minerals of lead, zinc, copper and iron, undertaken at Salt Lake City by the U.S. Bureau of Mines, has shown that the action of certain reagents produced coatings on the sulphide minerals employed.

The character of these deposits is now being studied, the addition of chemicals to flotation circuits having clearly proved that some of these compounds have a decided action on certain minerals. For instance, cyanogen compounds have a pronounced action on sphalerite and pyrite, which retards their flotation, while galena is apparently unaffected. Other addition agents make sphaltrite amenable to flotation, while the pyrite is apparently unaffected. The work of the past fiscal year has been already applied commercially in some of the plants in Utah, with considerable success; and for the reason that the flotation process is being relied upon as a means of increasing lead, zinc, and copper production, the problem becomes very important.

Steel Prices to be Controlled

IT is officially announced that the Associated Steelmakers in England and Scotland have agreed, after a year of free prices, to re-establish controlled prices for certain classes of steel. This step has been decided upon owing to keen price-cutting and the difficulty that makers have under present conditions of producing at remunerative levels. For the home trade ship plates are fixed at £7 10s. per ton—an advance of 2s. 6d.—and sections at £7. Ship plates for export are £7 per ton, but sections for export remain free. The makers are now members of the Steelmakers' Association, and it is believed that the present effort to keep the price at a profitable level will be more successful than has been the experience of the past. North-east coast steelmakers have for some little time past been adhering to the fixed price of £7 7s. 6d. for steel plates and £7 for sections for the home trade, but for export there has been keen price-cutting.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ANALYSIS.—Volumetric determination of uranium, vanadium, copper and iron in uranium ores. A. S. Russell, *J.S.C.I.*, March 12, 1926, pp. 57–60T.

The estimation of cerium in alloy steel. K. Swoboda and R. Horny. *Z. anal. Chem.*, No. 10, 1926, pp. 386–398 (in German).

Analysis of commercial magnesium. R. Guérin. *Ann. Chim. Analyt.*, February, 1926, pp. 34–40 (in French).

The determination of small quantities of silver in lead. E. Donath. *Chem. Zeit.*, March, 1926, p. 222. The solution of the metals is treated with glycerol, ammonia, and potash, and heated, the silver being precipitated.

COPPER.—The recovery of scrap copper. A Bregman. *Metal Ind.* (*N. York*), March 1926, pp. 102–104.

The influence of gases on copper at high temperatures. Part I. A. G. Lobley and D. Jepson, *Engineering*, March 19, 1926, pp. 380–381. An examination of the effect of nitrogen, hydrogen and carbon monoxide.

CORROSION.—Corrosion of iron. W. G. Whitman, *Chem. Reviews*, January, 1926, pp. 419–435. Discusses the effect of oxygen, velocity of the water flow, and dissolved salts on the rate of corrosion.

ELECTRO-DEPOSITION.—The electro-deposition of zinc from sulphate solutions. A. L. Marshall. *Trans. Faraday Soc.*, December, 1925, pp. 297–318. A study of the conditions affecting the efficiency of zinc deposition.

Chemical analysis and the electro-plater. J. Haas and E. R. Unruh. *Metal Ind.* (*N. York*), January, 1926, pp. 16–17, and February, 1926, pp. 70–72. On the value of chemical analysis and its limitations in the plating plant.

ELECTROLYTIC SEPARATION.—A new method for the electrolytic separation of metals. Denton J. Brown. *J. Amer. Chem. Soc.*, March, 1926, pp. 582-583.

GENERAL.—Methods for determining the orientation of the crystals in metallic conglomerates. G. Tammann and A. Müller. *Z. Metallkunde*, March, 1926, pp. 69–74 (in German). An illustrated article dealing with copper, iron and zinc.

Metal working and its technical-scientific development in recent years. Part II. J. Czochralski. *Z. Metallkunde*, February, 1926, pp. 43–50 (in German). This paper is concerned with zinc, tin, lead and aluminium.

Temper-colours, tarnish-colours and other tints on metals. U. R. Evans. *J.S.C.I.*, March 26, 1926, pp. 211–215.

IRON AND STEEL.—The winning of iron from silicates and pyrites. G. Tammann and G. Bätz. *Z. anorg. u. allg. Chem.*, February 15, 1926, pp. 129–139 (in German). A description of methods for the reduction of natural silicates and sulphide of iron.

Annealing iron and steel electrically. H. Fulwinder. *Blast Furnace and Steel Plant*, March, 1926, pp. 130–132.

The manufacture of iron and steel Part IV. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, March, 1926, pp. 458–470. Describes the manufacture, properties and uses of wrought iron, malleable iron and semi-steel.

The physical chemistry of steel-making processes. *Trans. Faraday Soc.*, December, 1925, pp. 169–292. The following subjects are dealt with: physical chemistry in steel making; balanced reactions in steel manufacture; a study of the reactions of the basic open-hearth furnace; chemical reactions of the basic electric process; equilibria in systems involving ferrous oxide; slag-reactions; the function of ferric oxide in acid and basic open-hearth slags; physico-chemical phenomena from melt to ingot.

The qualitative and economic importance of acid electric steel. Part. II. A. Müller-Hauff. *Stahl u. Eisen*, March 4, 1926, pp. 289–294 (in German). Discusses the influence of the acid electric furnace treatment on the structure of steel and compares the products with various basic steels.

REFRACTORIES.—The micro-examination of steel-making refractories. W. J. Rees. *Trans. Faraday Soc.*, December 1925, pp. 293–296.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd.—Registered February 23, £500 debentures part of £10,000; general charge. *£3,859. July 24, 1924.

SHEEPBRIDGE COAL AND IRON CO., LTD.—Registered February 18, £3,600 debentures part of £750,000; general charge (except uncalled capital, etc.). *£531,950. October 12, 1925. Also registered February 27, £3,700 debentures part of £750,000; general charge (except certain property). *£531,950. October 12, 1925.

PALMAREJO AND MEXICAN GOLD FIELDS, LTD., London, E.C.—Registered February 26, £5,500 3rd debentures part of amount already registered; charged on property originally charged. *£222,210. January 12, 1925.

Satisfaction

PALMAREJO AND MEXICAN GOLD FIELDS, LTD., London, E.C.—Satisfactions registered February 26, £38,330, part of amount outstanding July 1, 1908; £18,797, part of amount outstanding July 1, 1908, and registered October 13, 1908, to April 22, 1909, the balance of £11,200 not having been issued; £93,500 registered April 6, 1910, to March 26, 1913, and February 26, 1926; and £28,595 10s. total issued of amounts registered July 25, 1919, and July 17, 1923.

German Steel and Coal Trust Formed

THE Rhenish-Westphalian Steel Trust, which is to be known as the Vereinigte Stahlwerke, is now practically arranged, and will begin active operations on April 18. The sanction of the shareholders of the various concerns in the trust, namely, the Phœnix, the Rheinstahl, the "Gelsenkirchen," and "Bochumer" Verein, the Deutsch Luxemburg, and the Vanderzypenwissen, is required, and this will be forthcoming, indeed it has been given already by the Phœnix, Vanderzypenwissen, and the Rheinstahl. The Thyssen, a private concern, is also a member of the trust.

At a meeting of the Phœnix Company last week, Herr Fahrenhorst, a director, stated that the purpose of the new trust was to reduce general expenditure by concentration of production, so that the various works would only turn out material for which they were best suited. The reorganisation would entail the cutting down of freights to a minimum and some workshops would have to be closed, but he did not believe that it would be necessary to dismiss either officials or workmen. The reduced costs of production would, it was hoped, bring down the prices and consequently lead to greater home and export trade. The headquarters of the trust is to be Dusseldorf for steel and Essen for the coal industry. The capital of the steel trust is fixed at 800 million marks, and long term loans are contemplated.

Hydrometallurgy of Zinc

IN the course of a study of the hydrometallurgy of zinc, being conducted by the U.S. Bureau of Mines at Salt Lake City, work on acid leaching has been recessed, the problems of treating zinc silicate ores having been solved. This year's work on this problem is being confined to the more economical purification of zinc solutions by the means of zinc amalgam, and methods for discarding some of the zinc solutions so as to allow more wash water to be added, so that the soluble zinc now being lost may be saved. Co-operative work is being done with commercial companies on the development of a complete process by which the zinc in a complex ore may be leached out with ammonia after roasting, precipitated as a basic carbonate and converted to an excellent grade of commercial zinc oxide.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business, should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Metallurgy and Uses of Vanadium and Titanium

By G. Malcolm Dyson, Ph.D., A.I.C.

In a variety of ways vanadium and titanium offer great interest to the metallurgist, and their possibilities are still being explored. The following is an account of their distribution, preparation, properties, and uses.

THE element titanium is one of those metals that are by courtesy called "rare," it being, in truth, very generally distributed throughout the earth's crust, albeit in small quantities. It has been computed that titanium is the ninth element in the scale of abundance, being as widely distributed as potassium. This being so, it is only owing to the peculiarly difficult metallurgy of the element and its distribution in such small quantities that it has not hitherto attained prominence.

The presence of the earth in the mineral menachanite—or, as it is now called, ilmenite—was discovered by the Rev. W. Gregor in 1789, but the pure metal was unknown until 1910, the specimens hitherto passing as pure titanium being but alloys of the metal with its oxide, carbide or nitride. The principal titaniferous minerals are :—

Mineral.	Formula.	Maximum per cent. of Ti.
Rutile	TiO_2	58
Brookite	TiO_2	58
Anatase	TiO_2	58
Ilmenite	$FeTiO_3$	32
Titanite (Sphene)	$CaTiSiO_5$	23
Titaniferous ironstone	—	1–40
Bauxite	—	0–2

The ore chosen will, of course, depend on the purpose for which it is to be used. Thus, where the chemical compounds of titanium are required only, a high grade of rutile is chosen, while the same ore is well suited for the production of the pure metal. Much, however, of commercial titanium is used in the shape of the ferro-titanium alloy, which can be more easily prepared from ilmenite. The following analyses give some idea of the purity of ilmenites used for this purpose :—

	Average Ore.	High-grade Canadian Ore.
TiO_2	15–20	42–52
SiO_2	1–2	1–2
FeO	50–54	43–55
P	0·015	Trace
S	0·023	Trace
CaO, MgO, Al_2O_3	23–33	2–3

The Extraction of Titanium

Titanium is not widely used in the metallic state, partly on account of the difficulty of extraction, partly owing to its strong affinity for oxygen and nitrogen ; indeed, owing to the extreme readiness with which titanium unites with these elements, it is rarely seen unmixed with its oxide or nitride. It can, however, be prepared by the reduction of its oxide with carbon in the electric furnace, or by the decomposition of its tetrachloride by sodium under the influence of heat. The pure metal is white and has a fracture similar to that of steel, which alloy it resembles generally in its physical properties. Its density, 4·8, is comparatively low, but its high melting point, about 2,000° C., renders it very refractory. Worked cold, it is brittle and intractable, but at a cherry red it may be forged with ease, although the presence of even a trace of the carbide destroys this property, and gives an alloy which is hard enough to scratch quartz and which is exceedingly brittle.

Chemically, titanium is very reactive, giving rise to several interesting series of compounds, while physically its interest lies in its infusibility, which has led to its adoption as a filament material in electric lamps. It combines high resistance with a great emissive power, but owing to the fact that titanium metal cannot be drawn into wire the following device is used to circumvent this difficulty. Titanium oxide is made into a paste with a suitable viscose binder, and the mixture is squirted through a fine hole and then dried. By passing a current at a fairly high voltage but of comparatively small intensity through the dried filament, the carbonaceous matter reduces the oxide to the metal, giving what is virtually a titanium filament.

The use of the metal in steel practice is that which has led to its widest commercial use. Curiously enough, the titanium itself is practically wholly eliminated from the finished steel. The unique property shared by vanadium and titanium is that of removing nitrogen as well as oxygen from the steel, so giving a steel free from these impurities. The production of ferro-titanium alloys, which are used for this particular purpose, is done in two ways. The titaniferous iron ore can be added to the burden of the blast furnace and the titanium allowed to react on and purify the resultant metal, or titanium can be added later to the melted metal in the form of a high percentage titaniferous iron obtained by electrical smelting.

If the former process is chosen a low percentage titaniferous ore is usually charged, for although there is no difficulty in running an ore containing up to 40 per cent. of TiO_2, there is no economic advantage in doing so. The slagging, too, is altered so that the titanium is removed almost completely as calcium titano-silicate, an average sample of this slag analysing at :—

TiO_2	35 per cent.
CaO	25–33 „ „
SiO_2	28–30 „ „
Fe_2O_3	2–12 „ „

The actual amount of titanium in the steel produced by this method is surprisingly small, about 0·054–1·0 per cent., but the steel is much cleaner and sounder than normal steel.

The electric furnace methods involve reduction of the oxide with carbon in a bath of molten steel, and yield alloys with up to 80 per cent. of titanium. They are less fusible the higher the percentage of titanium, and even with low percentages are very tough and resistant. In the early days of titanium steel a man was sent out to break up a small trial ingot of steel containing about 5 per cent. of titanium. He returned after half-an-hour with the ingot intact, but carrying the fragments of the sledge !

Ferro-titanium alloys from the electric furnace contain about 4·5 or 5 per cent. of carbon, which can, however, be avoided by the reduction of the oxide with aluminium. The electric furnace is charged with molten aluminium, and the finely ground ilmenite is added until no free aluminium remains in the bath. Analysis of a normal run in this process gave a final alloy of the following composition :—

Titanium	76
Iron	21·5
Silicon	1·61
Sulphur	0·08
Carbon	0·90
Phosphorus	Nil
Aluminium	Nil

The use of titanium steel is still in the experimental stage and opinions are divided regarding its utility. The action of titanium as a deoxidiser and denitrogeniser is, however,

uncontested, and large quantities of ferro-titanium are used for this purpose. The precautions to be observed in its use in this direction are—firstly, that the addition of the ferro-titanium should be made after all other additions, preferably in the pouring ladle; secondly, that contact of the ferro-titanium with the slag (with which it reacts very readily) should be avoided; and, thirdly, that the alloy should be given at least ten minutes in which to react with the impurities.

Vanadium in the Steel Industry

The position of vanadium in the steel industry is, however, rather more safely established, and vanadium steels have a definite place in modern steel practice. The admixture of 0·2 per cent. of vanadium to steel gives an alloy which is extremely tough and which retains its temper well on heating, and is therefore of utility as a high-speed tool steel.

Vanadium is by no means so abundantly distributed in nature as titanium, although it is, in small quantities, as widely disseminated. Many minerals contain the metal, and until quite recently the commercial source of the metal and its compounds was the mineral mottramite, a basic lead-copper vanadate $(Pb_2Cu)_3(VO_4)2(Pb.Cu)(OH)_2$, whilst among the other vanadiferous ores may be mentioned the following :—

Vanadinite	$3Pb_3(VO_4)_2.PbCl_2$
Dechenite	$(Pb.Zn)(VO_3)_2$
Roscoelite	A vanadiferous mica

The latter mineral, roscoelite, would be an extremely valuable one if it occurred in any considerable quantity, since it analyses as follows :—

V_2O_3	24
SiO_2	45
Al_2O_3	10–12
K_2O	10
FeO	1–2
Other mineral matters	2–5
Water	5

The keuper sandstone beds of certain localities have been found to have the mineral grains coated with a thin layer of mottramite. This peculiar conglomerate on digestion with hydrochloric acid loses the mottramite coating, leaving the sand grains untouched. Vanadium can be obtained from the solution by precipitation as ammonium vanadate. The actual expenditure is heavy and the preparation of the element and its pure compounds is tedious by this method, so that since the discovery of extensive deposits of patronite in South America the earlier process has been practically forsaken.

Preparation of the Metal

The newer ore patronite is virtually a mixture of the sulphide of vanadium with hydrocarbons and free sulphur. The metal is obtained by roasting the ore, thus obtaining a clinker which contains about 40 per cent. of vanadium oxide and practically no sulphur. This is then reduced by carbon or by the alumino-thermic process. The latter process is not particularly efficient, since the amount of aluminium consumed is very high, and consequently raises the cost of production. A process has been devised by which a mixture of crude vanadium oxide and carbon is fed in small quantities into a comparatively small carbon arc electric furnace. The addition of ore and reducing agent is continuous, as also is the removal of the metallic vanadium. By the use of methods similar to those described under titanium, ferro-vanadium alloys can be obtained containing up to 50 per cent. of vanadium.

The metal itself is brilliantly white and crystalline, and, like titanium, has a hardness superior to that of quartz or steel. Chemically, it is characterised by an extreme affinity for oxygen and by the formation of several series of brilliantly coloured compounds. The attraction for oxygen is shown by its behaviour with acids. Thus, with acids such as hydrofluoric, hydrochloric and sulphuric there is practically no action, but with oxidising acids such as nitric, chloric and perchloric acid there is solution with violence and rapidity.

The oxides of these two elements form an interesting pair of compounds, although from entirely different standpoints. Titanium dioxide in the pure state is a white and impalpably fine powder which, by its general physical properties and chemical inertness, is admirably suited for use as a white pigment. The raw material for this pigment is a species of ilmenite, the formula for which approximates to $(Fe.Mg)TiO_3 + 10Fe_2O_3$. The mineral, after sorting by hand, is crushed in a ball mill to a very fine powder and mixed with enough strong sulphuric acid to form a thick paste. On heating, a violent reaction sets in, and the paste is transformed to a hard mass of titanium and iron sulphates. The disintegrated mass is lixiviated with water, and on boiling the solution the higher titanium oxide is precipitated, leaving ferric and ferrous sulphates in solution. Filtration is useless to separate the precipitate from the mother liquor, so fine are the particles, and sedimentation is resorted to for washing and concentrating the precipitate. The dried sludge obtained from this process is not suitable, without further treatment, for use as a pigment, having but a slight opacity and containing water of hydration, which renders it unsuitable for admixture with the usual paint vehicles. The substance is therefore calcined. The furnace used for this operation is of the rotary type, very similar to those used for cement roasting. The titanic acid is converted by the roasting into a microcrystalline form of titanium dioxide, and after the heat treatment is ground and sorted by air levigation. Great care is essential in the regulation of the temperature of calcination, since the process must be carried far enough to remove all the water, and to develop the crystalline structure of the oxide, but not so far that the material is converted to the gritty or completely crystalline state.

Titanium White

In practice it is found that the process is more easily controlled if the titanium oxide is mixed with a quantity of barium sulphate, and that the quality of the final product is more suitable for a pigment. The best ratio for such a mixture is that of equimolecular proportion, but commercially two grades are recognised—"titanium white" containing 25 per cent. of TiO_2, and "extra titanium white" containing up to 75 per cent. of the oxide. The sulphate must be added to the pulp before calcination, and it is advisable to add at the same time a small quantity of barium carbonate to neutralise any traces of acid that may be present. The titanium white produced by following the above process exactly has invariably a slight yellow tinge, which detracts considerably from its use as a pigment. The yellowness was at one time thought to have been due to a persistent trace of iron adsorbed on to the surface of the particles, but subsequent research has shown that the colour is due to some change in the state of the oxide, which can be completely arrested if a trace of phosphoric acid is present during calcination.

Titanium white prepared in this manner has a very pure white colour not surpassed by any other pigment. It has the merit of being the most stable compound of titanium and is unaffected by the usual impurities in air which bring about discoloration, including sulphuric acid, hydrogen sulphide, and sea-water. It stands up well under exposure tests, showing no tendency to crack or peel, but wearing down evenly, and finally "chalking," thus leaving a uniform surface for repainting. The opacity is very high indeed, as would be expected, not only from the extremely fine state of subdivision of the material, but also on account of the very high refractive index of the oxide, 2·6–2·7—*i.e.*, higher than that of diamond (2·4) and nearly equal to that of selenium (2·9). The relative opacity, determined by the opacimeter of Pfund, is given below :—

Substance.	Opacity. (Equal weights)	Opacity. (Equal vols.)
Extra titanium white	130	140
Titanium white	100	100
Zinc oxide	77	88
Lithopone	65	77
White lead	46	66
Lead sulphate	35	58

In paint compounding it is well to use a small percentage of zinc oxide to act as a drier, since titanium white has no drying effect on the oil used. An added advantage is the fact that titanium salts are comparatively harmless pharmacologically, and for this reason the use of titanium paints is not likely to lead to an industrial disease, as in the case of lead compounds. Further, it may be mentioned that titanium dioxide is a useful opacifying agent in the manufacture of enamels and glaze for metal utensils, and on account of its refractory nature is used for the manufacture of vessels for high temperature work.

Vanadium pentoxide, on the other hand, is not used in bulk, but is valued for its catalytic activity in promoting oxidation. It has been used in the manufacture of sulphuric acid to

catalyse the oxidation of sulphur dioxide to the trioxide, and in the manufacture of nitric acid by the catalytic oxidation of ammonia. For these purposes the oxide is made up in the following way: Pure alumina is mixed with 10 per cent. of ammonium vanadate and the moist mixture compressed into briquettes which are then fired, decomposing the vanadate and leaving a porous block impregnated with finely divided vanadium pentoxide. In the realm of organic chemistry vanadium pentoxide catalyses the oxidation of benzene to maleic acid, of anthracene to anthraquinone, of toluol to benzaldehyde and benzoic acid, and of naphthalene to phthalic anhydride.

Among the other uses of titanium and vanadium compounds may be mentioned the use of titanium tetrachloride, in conjunction with chlor-sulphonic acid, for the preparation of smoke screens, the use of titanous chloride as a reducing agent and titration solution in organic and analytical chemistry, and the use of the titanous salts as mordants in the textile and leather industries.

Vanadium, as Berzelius observed, gives rise to a very permanent blue-black ink on treatment with a solution of galls, and a similar process is made use of in the blackening of leather. Vanadium salts are also used in the dyestuffs industry for the manufacture of vanadium black by the catalytic oxidation of aniline, while photographically vanadium salts are used to obtain green tones on bromide prints.

A Year's Progress in Metallurgical Research

Points from the N.P.L. Annual Report

During the past year some investigations of great importance have been carried out in the metallurgical department of the National Physical Laboratory. We publish below an account of some of the most prominent points raised in the report.

THE Report of the National Physical Laboratory for 1925 contains in its metallurgical section the record of much interesting work.

Efforts made to improve the properties of aluminium alloy castings have been crowned with success. Many of the defects in castings, ingots, etc., arise from the presence of gas in the molten metal. Trouble from this source may be avoided by allowing the molten metal to cool either rapidly or very slowly. A convenient method is that of pre-solidification; the metal, after melting and alloying, is allowed to cool in the crucible in the furnace until it has just solidified, when it is quickly reheated so as to melt it and raise it to the casting temperature, carefully stirred, and poured. The method has proved applicable to sand castings of Y alloy and one or two other light aluminium alloys, but not to all of them. Another alternative is to bubble an inert gas through the molten metal just before casting. These methods are in process of transformation to the commercial scale.

Ageing of Y Alloy

Further work on Y alloy has been directed towards its ageing; the process developed previously in the laboratory for the ageing of sand and chill castings of this alloy, involves soaking them for 6 to 12 hours at about 520° C., quenching in boiling water and subsequent ageing, completion of the latter process at room temperature requiring a period of from 6 to 10 days. Industrially such a delay is a serious difficulty, and it has been found that maintaining the castings after quenching for several hours in boiling water causes complete ageing. This method is likely to become the standard industrial practice in the production of heat treated castings of Y alloy. The properties of aluminium-silicon alloys have been investigated, particularly with regard to the "modification" which they undergo when small additions of sodium or of a molten flux containing an alkaline fluoride are added to them just before casting. The investigation concerning oxygen in aluminium has been completed, and it is found that oxygen, or aluminium oxide, is not soluble in aluminium, no oxide being present elsewhere than on the surface. This disposes of the belief that aluminium can be "burnt" by the absorption of oxide.

The work done on alloys of iron comes under four headings: the production of very pure iron and the study of its properties; alloys of iron and phosphorus; alloys of iron and manganese; and alloys of iron and chromium. Very pure iron has been prepared from molten electrolytic iron by passing a current of pure hydrogen over the surface, thus eliminating the last traces of oxygen. Reports have been presented to the appropriate committee on the heat treatment and microstructure of various spring steels. Carbon steel used in the manufacture of high pressure gas cylinders has been examined with a view to finding whether periodical heat treatment is desirable, and light-weight alloy steel gas cylinders have also been under scrutiny. An investigation of great and immediate practical interest is that of the heat treatment of chains used on ships and in shipyards. A considerable number of chains, both new and after use, have been subjected to successive straining by impact, alternated by either annealing or normalising. As a result of these and other tests, it is concluded that the toughness of chains becomes reduced on repeated overstraining either under test or in service, and can be restored by suitable heat treatment. During the year two further standardised steel samples were issued, No. 8 Carbon standard, with 0·27 per cent. carbon, and No. 9 Carbon standard, with 1·09 per cent. carbon.

High Temperature Alloys

The laboratory is collaborating in a research on the production of alloys for use at high temperature. As a preliminary, a systematic exploration of the alloys of nickel and chromium and study of their high temperature properties has been begun. The melting and casting of these alloys has been carried out by means of the high frequency induction furnace, the melting being done *in vacuo*. For this and other purposes a supply of pure chromium is required. The metal previously prepared by the electrolytic method had certain disadvantages, notably contamination with oxide. A new apparatus for the electro-deposition of chromium on a rotating cathode is under construction, and will, it is hoped, yield metal more coherent and containing less oxide than that hitherto obtained. The important industrial question of the amount of iron that is permissible in alloys for use at high temperature is receiving consideration.

With regard to the preparation of pure metals other than those already mentioned, it is reported that work on the production of pure aluminium has been abandoned, in view of the fact that a solution of the problem has been obtained in America. Efforts are still being made for the production of pure beryllium. Various improvements have been made in the electrolytic process, and though the carbon and iron content have been greatly reduced, there is reason to believe that the lack of ductility of the product is due to the presence of impurities which have not been detected. As a result, it has become necessary to investigate the methods of analysis of the metal. It is possible that the preparation of beryllium in an absolutely pure state may involve the adoption of a new method. The study of the alloys of beryllium and aluminium has been continued. The constitutional diagram of the system has been surveyed; and as a result of the investigation of the mechanical properties of the alloys consisting mainly of aluminium, it is concluded that these do not show any signs of great utility.

Miscellaneous Details

In addition to the fairly detailed accounts given above, it may be mentioned that work is in progress on impurities in copper, on the die casting of aluminium alloys, on the equilibria of the system iron-carbon-silicon, on special brasses, and in various other directions. In addition, a number of researches of a more purely scientific nature than those indicated above are under way. The theoretical ideas expressed by Dr. Rosenhain, the Superintendent of the Metallurgy Department, in regard to the inner structure of alloys, are being subjected to experimental test. The crystal structure of metals and alloys is being studied radiologically. Other investigations are concerned with the fatigue of single crystals of aluminium, the behaviour of metals and alloys under strain, the heat generated by plastic deformation, and the solubility of gases in metals.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institution of Mining and Metallurgy

THE thirty-fifth annual general meeting of the Institution was held at Burlington House on Wednesday, Sir Thomas Holland being in the chair. In presenting the report of the council, the chairman referred, among other things, to certain changes which the council were considering with regard to the election of members of council representing the members in the Dominions, and to the formal institution of the Benevolent Fund. The Hon. J. S. Smit, High Commissioner of the Union of South Africa, was present, and received the gold medal of the Institution on behalf of Sir Robert Kotzé, Engineer to the Union of South Africa, to whom the medal had been awarded in recognition of his work on safety in mines and the handling of the dust menace. The gold medal awarded by the Consolidated Goldfields of South Africa, Ltd., was presented to Professor L. H. Cooke, for his work on mine surveying.

Ageing of Light Metals and Alloys

AN enormous amount of research has of late been devoted to the subject of the ageing of aluminium and magnesium alloys. The property is connected with (but not always identical with) age hardening, and with the season cracking which takes place in certain brasses and bronzes. The three types of phenomena are, nevertheless, not to be confounded with one another. Season cracking is an unmixed evil; the ageing or maturing of aluminium alloys, and of alloys containing magnesium, is a highly beneficial process. In the case of the magnesium alloys the process appears, usually, to become accomplished, and to reach its maximum development, in the course of a few days only, although in most of the aluminium alloys it takes far longer to become completed. It can usually be accelerated by heating, and in the case of the magnesium alloys, even temperatures as inconsiderable as that of boiling water effect considerable increase in the tensile strength. The electrical conductivity and the chemical resistance of such metals also undergo modification by ageing, whether natural, or brought about by artificial means.

Causes of Ageing

K. L. MEISSNER is one of the most recent investigators of the phenomena under consideration. He has repeated the experiments of Fraenkel and Scheur on duralumin, and on other alloys of a similar type containing magnesium. It has been found that the electrical conductivity of naturally "aged" alloys and of artificially "aged" alloys, differs. According to Hanson and Gayler, the presence of the compound Mg_2Si plays an important part, its solubility at various temperatures, and its precipitation at others being the predominating cause of the observed variations in ageing effect at different temperatures. Meissner's own researches rather tend to confirm this view. On the other hand, the work of Bradley Stoughton and M. Miyake, described at the February meeting of the Institute of Metals Division of the American Institute of Mechanical Engineers, has shown that an even more rigorous heat treatment can be applied if the full strength and hardness of the aluminium-magnesium alloys is to be developed. Also the magnesium zinc alloys, of the elektron type, benefit greatly by heat treatment at temperatures as high as 340° C., and subsequent annealing at 150° C. The variety of the light metal alloys is enormous and their name is legion. "Lautal" and "Aludur" are amongst the latest additions to the series, and the medium weight alloys "Cindal" and E 11 A., are attracting a good deal of notice. Incidentally it is of interest to learn, from a recent patent application that the new "Maxium" alloys, which are practically pure magnesium, are treated with that dark horse amongst metals, calcium, and that they may owe to small percentages of that substance some, at least, of their remarkable properties.

Calcium and Cinematography

CALCIUM has recently been promoted to the honour of a Press paragraph, it being the alleged constituent of a "magic ring" to which reference was made in a case before the Law Courts. It was employed to give a pyrotechnical display capable of being recorded "on the film." The particular brand employed appears to have been somewhat impetuous in its action, and occasioned the wearer of the ring a nasty burn. People who play about with magnesium ribbon are apt to scorch their fingers painfully, for it has a habit of suddenly collapsing, even when in a holder, and falling, fortuitously, on the nearest object. The ignition point of calcium is high; it is usually placed at about 800° C. It explodes, however, in contact with several metals, and with phosphorus, and is said, under these circumstances, to emit a brilliant flash. It seems rather a dangerous element to play with. As, however, it is the lightest metal known, it seems to be an appropriate alloying element for magnesium. It has already been employed in a similar capacity in aluminium alloys, and has been used as a scavenger in other non-ferrous metals. It is also used, to a limited extent, as a hardener in certain anti-friction metals having a lead base. At the same time its properties and potentialities have not been thoroughly explored, and it may well be that the metal will, in time, be found very useful in technological metallurgy. It is one of the most abundant of all the elements, and its extraction and application to industrial purposes should offer no insuperable difficulties, either of a technical or of an economic kind.

Fuel Economy and Metallurgy

THE coal situation lends additional point and emphasis to the coal economy campaign, and should serve to direct and focus interest on the new Institute of Fuel Technology, which is under way. It is in good hands, and its destinies can be safely left to the provisional committee which has the shaping of them as its special concern. In the meanwhile, more and more is being heard of low-temperature carbonisation, and its possibilities; it is disappointing that its economic possibilities do not mature as rapidly as its theoretical advantages have promised. Mr. David Brownlie, who is a staunch advocate of low-temperature carbonisation, described, on April 22, at the meeting of the South Wales Institute of Engineers, at Cardiff, a number of new processes, mostly worked in Germany. They include the Dobblestein process, the Raffloer process and the Meguin process, all of which are fairly new to English readers. In the meanwhile the world awaits a truly successful omnibus process, in which the by-products and the residual coke will be of such value as to displace, once and for all, both the existing coke oven and the existing gas retort. It may be asking too much, but a sceptical public will, apparently, be content with nothing less. Above all the residual coke must be as cheap as coal, or cheaper; not bulk for bulk, but weight for weight. Metallurgy would gain hugely by the introduction of such an ideal fuel.

American Chromite Situation in 1925

IT is announced by the Department of Commerce, Washington, that the shipments of domestic chromite, all containing 45 per cent. or more chromic oxide, in 1925 totalled 108 long tons, valued at $2.105, according to figures compiled by the Bureau of Mines, Department of Commerce. These shipments came from two mines in California and one mine in Maryland. The production in 1925 was 157 long tons. Two mines in California, one in Maryland, one in Oregon, and one in Washington produced this tonnage. In 1924 there were 233 long tons of chromite produced and 288 long tons, valued at $1.140, shipped. Of the 288 tons shipped in 1924, 100 tons were from material mined in previous years, which contained less than 35 per cent. chromic oxide. Two mines in California and one in Montana produced; one mine in California and one in Oregon supplied the tonnage shipped. The total imports of chrome ore, containing 45 per cent. or more chromic oxide, for 1925 were 149,739 long tons, valued at $1,207,420. Of this total the major part came from the following countries (figures in long tons): Portuguese East Africa, 70,718; other Portuguese Africa, 6,805; British South Africa, 18,463; British East Africa, 678; Cuba, 29,830; and Greece, 12,533. In 1924 the total imports amounted to 118,343 long tons. In 1925 United States imports, therefore, increased by 31,396 tons. The increased output of steel during 1925 accounts only in part for the increase in imports of chrome ore. The ratio, chrome

used per ton of steel produced, has also increased, as chrome is being used more and more in the fabrication of special grades of steel for automobile manufacture. Furthermore, the material increase in the demand for higher grade refractories in the open hearth furnaces as well as in low temperature furnaces contributed to increased importation. The chemical uses have remained relatively constant. During the year the price of 45 to 50 per cent. chromic oxide ore varied between $20 and $23 per short ton f.o.b. shipping point. Ores running from 52 to 54 per cent. chromic oxide averaged approximately $24 per short ton. More than seven-tenths of the world's production now comes from Rhodesia. The mines are highly developed and are probably more extensive and more important commercially than any others now known.

"Staybrite" Steel: Properties and Uses

A NEW text-book, *The Development of "Staybrite" Steel: Its Properties and Uses* (pp. 96. 12s. 6d.), has been published by Thomas Firth and Sons, Ltd., of Sheffield. Staybrite steel differs from stainless steel in that it has a much higher chromium content, together with a substantial percentage of nickel. Moreover, stainless steels are martensitic, whereas "Staybrite" steel, after softening by quenching from a high temperature, is austenitic. The volume before us deals with the following aspects of the steel: its requisitioning: manufacture; manipulation; machining; mechanical properties; general physical properties; resistance to atmospheric and marine conditions; the effect of acids; effect of other influences (contact with general chemicals, foods, etc.); contact with other metals; applications; while the final chapter, by Dr. Hatfield (of the Brown-Firth Research Laboratories), deals with the theory of corrosion.

Of especial interest are the tables illustrating the great resistance shown by the steel towards acids other than hydrochloric and sulphuric acid. Its resistance towards nitric acid of concentrations up to 70 per cent. (and incidentally towards sulphuric acid containing nitric acid) obviously opens up a very wide field of application, which is increased by its resistance towards a large number of other chemicals. Atmospheric and marine conditions of great severity (*e.g.*, exposure in industrial areas and to sea-water, etc.) have no effect upon it. By virtue of these many valuable properties the steel finds use in many industries: in many branches of engineering (civil, marine, mining, railway, automobile); in chemical manufacture, for example in all plant dealing with nitric acid, notably for the erection of absorption towers, outlet pipes for stills, etc., in acid evaporators, in apparatus for nitrating processes, especially where mixtures of nitric and sulphuric acid are used, and in plant used in the china clay and allied trades; in food manufacture, such as flour mills, and the cocoa, chocolate, sugar and confectionery trades; in the domestic world, where it combines long service with elegant appearance; and in other spheres far too numerous to mention.

Cyanide Hardening

CYANIDE hardening of parts has become popular on account of the extreme hardness of the case obtained by this process, and also because the operation can be carried out easily and in a short time. On the other hand, only a very superficial case is obtained, and also there is a distinct line of demarcation between the outer case and the soft inner core, whereas, when box carburising is employed, the case merges gradually into the body of the metal. Cyanide hardening is most useful when small parts have to be hardened, and where resistance to shock and fatigue is not essential in the finished part. The salts used in this process are those capable of yielding nitrogen or carbon, such as the carbonates and cyanides of potassium and sodium. Some manufacturers employ soda ash and common salt with the cyanide.

Cyanide hardening may be accomplished in either of two ways. In some cases the pieces are plunged into a bath of molten cyanide, and in others they are sprinkled with the salts and then heated, the process being repeated until the required depth of case has been obtained. The latter process, which is sometimes known as the cyanide varnish method, is not so common as the former, because the results are not so good and it is not so simple to carry out. In the immersion process an open pot is filled with the salt mixture and suspended in a furnace. The mixture of salt used varies with the operator's experience, but two popular ones are 74 per cent. sodium cyanide with 26 per cent. sodium chloride, and 33 per cent. sodium cyanide with 33 per cent. sodium chloride and 34 per cent. sodium carbonate. This mixture fuses in the pot and forms the hardening bath. Cyanogen is evolved during the process and it is essential that proper measures are observed to remove the furnace fumes efficiently on account of their poisonous nature. As this cyanogen is evolved the efficacy of the mixture is gradually weakened, and considerable experience is necessary to estimate the strength of a salt mixture.

The temperatures at which this method of hardening is commonly carried out usually lie between 1,450° and 1,600° F., though in some cases the process is continued up to 1,700 deg. F. When the bath has attained the desired temperature the parts to be hardened are immersed cold and kept in the bath until they have reached the same temperature as the salts, the time required being anything from five minutes to a quarter of an hour. If the time of immersion is increased, the depth of the case is increased correspondingly, though protracted immersion is inadvisable on account of the damage to the containers. The parts must be quenched immediately in oil, brine, water or lime water, especially if they are small, to prevent warping. The cyanide process is very hard on containers, and the life of cast iron and steel is usually short on account of oxidation and the fact that holes soon burn through the metal where any defects exist. If this happens the cyanide is apt to leak through and ruin the furnace lining. The process gives the best results when used on small parts such as screw parts, nuts, washers and other articles of small sections.

"F. Steel"

ACCORDING to the German Press, further progress has been made in regard to the production of "F. steel," the new German product which attracted considerable attention a short time ago. It is said to be at least as strong as constructional steels now in use, and much lighter and cheaper. In truck construction, for example, it is claimed to give a saving of 30 per cent. in cost and 40 per cent. in weight. The steel derives its name from the Freund Smelting and Machine Manufacturing Co., of Berlin. The late Richard Jonas, managing director of the company, acquired the patent from a Swiss, Bosshardt, and experimented with the process for some years, using a special furnace for producing the steel on a small scale. Samples have recently been submitted to experts at the Dresden Technical High School, who have carried out a series of independent tests. The conclusions arrived at have not yet been published, but it is said that while the Dresden experts think the process still susceptible to improvement, "F. steel" gives better results than the constructional steel "St. 48," which has been hitherto regarded as the best all-round steel for bridge work. Special interest is being taken in the possibility of employing the new steel for railway purposes, its most promising property in this regard being its power of resistance to changing stresses. As yet, the commercial production of "F. steel" has not been undertaken.

Structure of Duralumin

A DETERMINATION of the structure of duralumin, *e.g.*, of the arrangement of the atoms of the elements composing it, is necessary for our better knowledge of this alloy. The *Journal of the Franklin Institute* for April contains a paper by R. J. Anderson on "An Atomic Picture of Duralumin and Its Crystal Structure." Measurements were made of eighty-six X-ray diffraction patterns of a low-copper (4·03 per cent. copper) and a high-copper (6·05 per cent. copper) duralumin. The duralumin sheets used were in various conditions, cold-rolled, annealed, quenched and aged, having had a variety of heat treatments. The data show that the duralumin lattice is substantially the same as the aluminium lattice, forming a face-centred cube. No change in the parameter of the aluminium lattice was observable in the low-copper alloy, but in the high-copper alloy the parameter was slightly decreased. Photographs are shown of the effect of cold-work and heat treatment on the diffraction pattern of duralumin. Duralumin is a complex solid solution containing at least copper and magnesium in solution in aluminium. The alloy is considered from this point of view and the hardening-on-ageing phenomenon is discussed. The precipitation of $CuAl_2$ and Mg_2Si from quenched duralumin on ageing is considered on the basis of diffusion.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

WHEN this appears in print it will be known whether we are to have peace or war in the coal trade. On Friday night, April 30, the Government subsidy ends and the present working conditions and wages terminate. Unless in the meantime some agreement has been reached between the colliery owners and the miners, there appears to be no alternative but a strike, always supposing that the Government remains firm in its decision not to continue the subsidy.

The Coal Situation

It is a fairly general opinion that, even if things are patched up now, there will sooner or later have to be a contest between the two parties in order to decide in whose hands the control shall be; and if such a contest is to come, it may as well be while trade is bad, so that the air may be cleared and trouble avoided when trade is on the up-grade again. One fears that sooner or later this will have to take place. These continual outbreaks are doing lasting harm not only to the coal trade but to the whole industry of the country, and they seriously retard the revival in trade which is so much needed. Nevertheless, I do not think there will be a coal strike just now. If the owners and miners cannot find a basis of settlement, then the Government will. In view of the definite declaration of the Prime Minister the subsidy will have to cease, but the assistance may be given in some other form. Already a scheme is prepared which will replace the subsidy by a reconstruction loan. There is to be an interest-bearing loan to the industry for a period of years; the proposed conditions attached to the loan are that the interest shall be borne equally by the Government, the owners, and the miners and that the industry is immediately reorganised so that the uneconomic pits which have no prospect of producing except at a loss shall be closed.

Frankly, I do not see how the Government dare allow a coal strike to take place. The crisis last year was averted only by the grant of the subsidy, and in the absence of agreement between the owners and the men, the abrupt stoppage of State assistance is bound to precipitate trouble; therefore the Government must as a last resource find something to take the place of the subsidy. There have been hopes and even indications that the bottom of the depression in trade had been reached and that we were really on the upward turn. A coal stoppage at this point would be so serious a disaster to the country that for its own credit's sake the Government must find some means of preventing it, so that the return to a more healthy economic condition shall not be retarded.

Engineering Trouble

But the coal crisis is not the only trouble. Behind that looms the threat of an engineers' strike, which in some respects is even more serious. A settlement of the coal dispute on the lines of further aid from the State would probably have the effect of stiffening the backs of the engineers in their demands, and as a Union they are in a better position to meet the cost of a strike than the coal miners. Their demand is for an all-round advance of 20s. per week. The masters have replied by offering an advance of 2s. 6d. per week, but they do not hope to get the matter settled so cheaply. The margin between the two figures has to be reduced, and negotiations are proceeding with that object. The engineers are very sore, and it cannot be denied that in comparison with many other classes of workers they have a distinct grievance. When the skilled engineer knows that the unskilled man working on the roads is getting more money than himself, and that the same relative condition applies in respect of many other occupations for which no apprenticeship or skilled training is required, it is not to be wondered at that he becomes resentful, and it will require very tactful persuasion to induce him to continue in his inferior position as a wage earner. The engineering industry is not at present in a position to grant the whole of the advance that is demanded, but something will have to be given, and how much that is and the manner in which it is conceded are matters which will animate the discussions between the masters and the men. If the engineers came out on strike it would probably not be of short duration, and the effect on the allied industries, the iron and steel trade and even the coal trade, would be slowly cumulative and entirely disastrous. At the moment there is not much ground for making a forecast of the situation, and all one can do is to "wait and see" in the hope that good sense will prevail and a peaceful settlement be reached.

Iron and Steel Prospects

The iron and steel trade is bearing up as well as can be expected under its load of trouble. It is directly interested in the two industrial crises which are confronting the nation and cannot hope to do more than mark time until these disputes are settled. A coal strike means the immediate stoppage of the iron and steel works. An engineers' strike means the stoppage of the engineering establishments, and with them a large proportion of the orders on which the steel trade is now depending. No wonder that confidence is still lacking and that business is of a desultory nature.

Notwithstanding this, there is no doubt that the market has a healthier tone than for some little time past, and when the industrial troubles have been disposed of, there should be speedy and definite signs of better trade. One certain cause of this improved tone is the recent agreement among the steel makers as to minimum prices. Practically all the English and Scottish makers are parties to the agreement, which now covers plates, sections, and bars, so that for the present at any rate there is an end to the fierce competition that has been raging between the different works. The advance of 2s. 6d. per ton in the price of plates and sections, which was decided at the meeting of the associated makers held on April 15, has made it clear that there is no hope of lower prices and that any further alteration must be upwards. This knowledge will most certainly encourage business, and as soon as the threats to continuity of working are removed we are expecting to see a steady inflow of orders.

The prices which are now fixed are £7 17s. 6d. basis for plates, with a reduction of 2s. 6d. for Leeds district and the North East Coast, £7 2s. 6d. for sections, and £8 2s. 6d. for bars 3 in. and up. These are minimum prices, and the extras follow very much on the lines of the lists which were drawn up in 1921. Much depends on the observance of the agreement by the various makers, and it is very desirable that it should continue until the industry has in a measure found its feet again. A testing time will come when the new Appleby Steel Works come into operation, with their potential capacity of 4,000 tons per week. If they can be induced to join in with the other makers, well and good; if not, we may be thrown back to the unsatisfactory position which has been experienced for so long. It must not be supposed that the prices now fixed are lucrative ones. In most cases they are below the cost of manufacture, and it is only by the aid of the extras and the special prices which can be obtained for special qualities that the makers are enabled to keep going. Still, a start has been made in the right direction, and the future is not without hope.

Continental Competition

Continental competition is still active, and the prices quoted for the various classes of steel are well under those ruling here, the margin varying from about £1 per ton on plates to £2 per ton on bars. There is not a great deal of buying even at these low prices, particularly in the finished materials. Semi-steel is the busiest section, and there are still large quantities of Continental steel being brought into England for re-rolling. The bars thus produced are competing strongly with the home product, particularly in the bright drawn trade.

There is some satisfaction to be derived from the production figures for March. The pig iron output of 568,500 tons is the highest since May last, and there were five more furnaces in blast at the end of the month than at the beginning. The increase in the steel output was even more marked, the total being 784,100 tons, which is the highest since May, 1924, and nearly 100,000 tons higher than March last year. The export of iron and steel, amounting to 406,500 tons, was also the highest since May, 1924. It is true that compared with February the imports rose 30,000 tons, but the increase in exports was 67,000 tons. These figures may also be evidence that the industry is returning to more normal conditions.

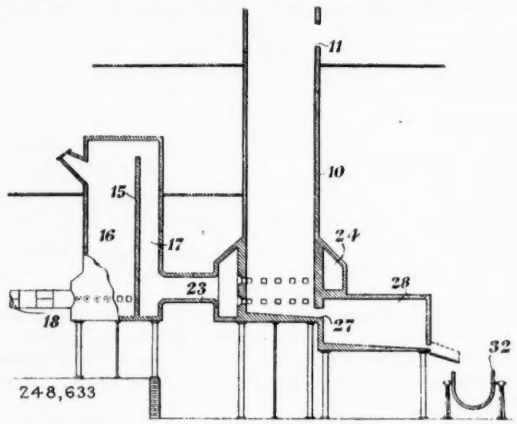
Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Reduction of Iron Ores

A PROCESS has been patented by Y. A. Dyer, of Southern Metallurgical Co., Cave Spring, Ga., U.S.A., which ensures a material saving in coke consumption and an increased yield of metal relatively to the size of the furnace. The mixture of ore, limestone, and coke is fed through a charging door 11 at the top of the cupola furnace 10. Carbonaceous material is completely burned to carbon dioxide in a chamber 16 by means of air supplied through the pipe 18 and tuyers 20. The gas passes over a partition 15 to a smaller chamber 17 and passage 23 leading to an annular chamber 24 surrounding the base of the furnace 10. The metal is drawn off through a tap hole 27 and forehearth 28, to the ladle 32. The ore, coke, and limestone alternately fill the furnace from the bottom upwards, and the carbon dioxide impinges on and through a thin bed of coke and is thereby converted into carbon monoxide.



This deoxidises the ore above it until the bottom charge of coke burns away, and the hot carbon dioxide then comes into direct contact with the metallic sponge which is thereby melted and passes to the forehearth. The next charge of coke then passes to the hearth for reaction with the carbon dioxide. See Patent No. 248,633, dated August 10, 1925.

Production of Steel

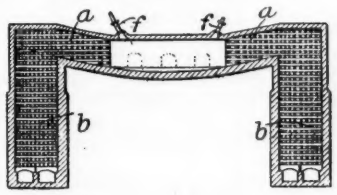
IN a process for obtaining steel from ore patented by A. Brüninghaus, of Dortmund, Germany, the ore and fuel containing carbon are fed into a bath of crude iron in a converter. The blast which is fed to the converter is enriched with oxygen, which is necessary to obtain the temperature required, *i.e.*, 1,400° to 1,500° C. The process is applied to phosphoric ores to obtain an intermediate product containing carbon and a little phosphorus, this product being further treated in a hearth furnace. The charge is fed to the converter through a vertical shaft and a slightly inclined rotary cylinder, the speed of which can be varied to vary the rate of charging. The waste gases pass upwards through the cylinder and shaft, thus preheating and reducing the ore. See Patent No. 249,186, dated December 10, 1924.

Cast Iron

ACCORDING to a process by Gelsenkirchener Bergwerks Akt.-Ges., of Gelsenkirchen, Germany, cast iron with the finest distribution of graphite is obtained by heating the molten iron 100° to 200° C. over the temperature at which the carbide decreases and the formation of graphite increases. Thus cast iron containing 3·46 per cent. carbon is heated to 1,200° C. and then has 3·34 per cent. graphite and 0·12 per cent. carbide. A small amount of iron thus treated may be mixed with iron which is heated just above its melting point. See Patent Application No. 247,941, having the International Convention date, February 21, 1925.

Refining Iron

IN a furnace for smelting and refining iron, steel, etc., solid, liquid, or gaseous fuel is injected through burners *f* at an angle of about 90° C. into a stream of hot air passing through the furnace. By this means, hot, short, narrow flames are directed on to the charge. The waste gases then



pass through regenerators *a*, *b*, which are used for preheating the air for combustion of the fuel. See Patent Application No. 248,012 (P. Kuhn, of Niederschelden, Germany), having the International Convention date, February 23, 1925.

Electrolytic Production of Zinc

Two inventions have been patented by S. Field, E. F. Petersson, W. E. Harris, and The Metals Extraction Corporation, Ltd., all of London. The ore may be roasted in air or in steam to oxidise sulphur compounds of zinc, or it may be roasted partly in air and partly in steam as described below. If roasted in air, the temperature should be about 650° C., to ensure that the minimum quantity of ferrites and manganites is formed. The ore is then crushed and gradually added to sulphuric acid at 85° to 90° C., containing 10 to 20 per cent. of free sulphuric acid, which may be the regenerated acid from the electrolytic cells. The acidity is reduced by this means to 0·2 per cent., and any rich zinc-bearing material is then added. Calcium carbonate in the form of whiting is then added slightly in excess of that necessary to neutralise the acid, and by this means the dissolved silica is completely precipitated. A small amount of "cell mud" (a mixture of lead peroxide and manganese dioxide obtained from the electrolytic cells) is then added, and the iron, cobalt, arsenic, and antimony are thus precipitated. The solution is filtered hot, and is then treated for the removal of copper, cadmium, arsenic, antimony, cobalt, and nickel. The temperature is maintained at 80° to 100° C. and about 0·01 to 0·02 per cent. of mercuric sulphate added, together with 0·1 to 0·2 per cent. of zinc powder. The solution is then acidified with some of the regenerated acid from the cells, and electrolysed until the solution contains about 12·5 per cent. of acid. The various impurities precipitated in the process may be treated for the recovery of their metal contents.

The second patent describes the preferred method of roasting the ore which is to be purified as described above. The ore is roasted at 650° C. until the sulphur content is reduced to such a point that the presence of steam does not cause the production of sulphuretted hydrogen. Steam is then admitted with the air, and it is found that the proportion of ferrites and manganites produced is less than if air were used throughout. See Patents Nos. 249,609 and 249,764, dated December 29, 1924.

Hadfields and Price Cutting

HADFIELDS, LIMITED, the well-known Sheffield manufacturers of steel castings, mining and crushing machinery, and other steel products, did better in 1925 than in either of the preceding two years (states *The Times*). Profits amounted to £117,660, as against £80,621 in 1924 and £106,510 in 1923; these figures represent a very modest return on the total capital employed. Before the war a profit of £139,000 was earned on a capital less than one-fourth of the present figure. Fortunately the profits suffice to pay a dividend of 3 per cent. on the ordinary shares, against 2½ per cent. for 1924 and 4 per cent. for 1923, and the amount carried forward is raised slightly from £80,522 to £83,204. It will be seen that the improvement, though welcome, still leaves prosperity a long way off. The company suffered, like others, from severe price cutting owing to the keenness of competition. Reference is made to the company's acquisition of control of Harper, Sons, and Bean, manufacturers of the Bean car, whose business has been reorganised, the management strengthened, and the financial position put into a satisfactory condition.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Properties of some sand-cast alloys of aluminium containing silicon and magnesium. S. Daniels. *J. Ind. Eng. Chem.*, April, 1926, pp. 393–398.

Ageing of aluminium alloys. K. L. Meissner. *Metal Ind. (Lond.)*; Part I, April 16, 1926, pp. 363–364; Part II, April 23, 1926, pp. 391–393. Discusses the effect of ageing on the electrical conductivity and chemical resistance.

Cementation of iron alloys with chromium. J. Laissus. *Rev. Métallurgie*, March, 1926, pp. 155–178 (in French).

Contribution to the knowledge of the system iron-tin. F. Wever and W. Reinecken. *Z. anorg. u. allg. Chem.*, March 12, 1926, pp. 349–372 (in German).

ALUMINIUM.—Aluminium foundry practice. G. Mortimer. *Metal Ind. (Lond.)*, April 2, 1926, pp. 319–320.

The behaviour of aluminium towards iron at high temperatures. R. Irmann. *Z. Metallkunde*, April, 1926, pp. 121–122 (in German).

ANALYSIS.—The determination of carbon in iron, steel and ferrous alloys by combustion in a stream of oxygen. E. Schiffer. *Stahl u. Eisen*, April 8, 1926, pp. 461–468 (in German).

The complete analysis of brass. Part VI. *Metal Ind. (Lond.)*, April 9, 1926, pp. 344–345. Deals with electrolytic methods.

Determination of oxygen and hydrogen in metals by fusion in vacuum. L. Jordan and J. R. Eckman. *J. Ind. Eng. Chem.*, March, 1926, pp. 279–282.

CORROSION.—Factors other than dissolved oxygen influencing the corrosion of iron pipes. J. R. Baylis. *J. Ind. Eng. Chem.*, April, 1926, pp. 370–380. A study of the products of corrosion and their formation.

ELECTRO-DEPOSITION.—Notes on heavy and rapid copper deposition. J. S. Sunderland. *Metal Ind. (Lond.)*, April 16, 1926, pp. 367–368.

GENERAL.—Relationship of metallurgy to the development of aircraft. J. B. Johnson. *Trans. Amer. Soc. Steel Treating*, April, 1926, pp. 517–538.

What happens when metal fails by "fatigue"? H. F. Moore. *Trans. Amer. Soc. Steel Treating*, April, 1926, pp. 539–552.

IRON AND STEEL.—The application of special cast irons in the engineering industry. S. E. Dawson. *Metal Ind. (Lond.)*; Part I, March 19, 1926, pp. 277–279; Part II, March 26, 1926, pp. 303–304; Part III, April 2, 1926, pp. 327–328.

Facts and principles concerning steel and heat treatment. Part V. H. B. Knowlton. *Trans. Amer. Soc. Steel Treating*, April, 1926, pp. 615–636. This article covers the mechanism of steel failures.

Some comments on Swedish steel practice. B. Kjerrman. *Trans. Amer. Soc. Steel Treating*, April, 1926, pp. 585–596. A resumé of the methods used in making iron and steel in Sweden.

General principles of the beneficiation of iron ores. T. T. Read. *Blast Furnace and Steel Plant*, April, 1926, pp. 172–179. An economic discussion of the extraction of iron from various ores.

Tungsten steels. A. H. Kingsbury. *Trans. Amer. Soc. Steel Treating*, April, 1926, pp. 597–603. Their characteristics and applications.

The hardening of steel; a review and some comments. Part I. W. T. Griffiths. *Metallurgist*, March 26, 1926, pp. 34–36.

PYROMETRY.—Thermo-electric pyrometry. A. E. R. Westman. *Canad. Chem. Met.*, April, 1926, pp. 77–80. A discussion of the selection, installation, care and calibration of pyrometers.

The science of temperature measurement. H. M. Brown. *Ind. Chem.*, April, 1926, pp. 166–168.

VANADIUM.—The mineral resources of the world. Part VII. Vanadium. M. Fourment. *Rev. Métallurgie*, March, 1926, pp. 132–142 (in French).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

APPLEBY IRON CO., LTD.—Registered March 1, Trust Deed dated February 10, 1926, securing £650,000 5 per cent. guaranteed debenture stock to rank in priority to £1,050,000 1st debenture; charged on properties at Frodingham and Scunthorpe and Appleby, also general charge. *£1,050,000. November 24, 1925.

BARRONIA METALS CO., LTD., London, S.W.—Registered March 22, £1,100 and £1,500 Land Registry charges, to Baron Southborough and another, 17, Airlie Gardens, Campden Hill, W.; charged on Albion Cottage, and 59, Parsons Green Lane, Fulham.

BLAENAVON CO., LTD., ironmasters, etc.—Registered March 12, £12,000 1st debentures to Bishopsgate Nominees, Ltd., 15, Bishopsgate, E.C.; general charge (excluding locomotives and rolling stock). *£204,364 1st, £225,000 2nd, and £36,000 prior lien debenture stocks. December 22, 1925.

BOLCKOW, VAUGHAN AND CO., LTD., Middlesbrough, ironmasters.—Registered March 19, £20,000 2nd debentures to Sir H. Mensforth, Bushey Hall Hotel, Bushey; general charge. *£2,322,000. December 22, 1925.

METAL CASTINGS, LTD., Worcester.—Registered March 23, £30,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £10,400; general charge (subject to prior charges). *£55,683. January 13, 1925.

MONDEGO TIN DREDGING CO., LTD., London, E.C.—Registered March 25, £22,500 (not ex.) debenture, to Montin Syndicate, Ltd., Sardinia House, Sardinia Street, W.C.; general charge.

MONDEGO VALLEY TIN SYNDICATE, LTD., London, E.C.—Registered March 25, £22,500 (not ex.) debenture to Montin Syndicate, Ltd., Sardinia House, Sardinia Street, W.C.; general charge (subject to debenture dated March 25, 1925); also registered March 25, £22,500 (not ex.) debenture to Mondego Tin Dredging Co., Ltd., 85, London Wall, E.C.; general charge (subject to debenture dated March 25, 1925, and above debenture). *£5,000. May 28, 1923.

PALMERS SHIPBUILDING AND IRON CO., LTD., Jarrow-on-Tyne.—Registered March 18, Trust Deed dated March 10, 1926 (supplemental to Trust Deed April 9, 1919), securing £200,000 further consolidated mortgage debenture stock repayable at a premium of 2½ per cent.; charged on property and assets comprised in the specific and floating charges created by original Trust Deed. *£1,190,953. September 24, 1925.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield.—Registered April 7, £1,100 debentures (part of £750,000), general charge (except uncalled capital and certain property). *£531,950. October 12, 1925.

Big Darlington Steel Contract

A CONTRACT officially stated to be worth £252,000, one of the largest placed in Darlington in recent years, has been received by the Cleveland Bridge and Engineering Co., Ltd. from the Port of London Authority, for the erection of a new floating landing stage for Tilbury. The work will take two years to complete, and will necessitate the manufacture of 6,000 tons of steel, whilst a large amount of woodwork will also be needed.

The approach from the river side to the landing stage will be 240 feet long, and 70 pontoons are required to float the stage.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Communications relating to advertisements and other business, should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.*

Reactions in an Iron Blast Furnace

An American Investigation

We publish below an abstract of a paper entitled "Study of the Reactions in an Iron Blast Furnace," by S. P. Kinney, P. H. Royster and T. L. Joseph, issued by the U.S.A. Bureau of Mines. The work on which the paper is based was carried out under the auspices of the Bureau.

THE study described in this paper, on the reactions in an iron blast furnace, is part of the investigation being conducted by the U.S.A. Bureau of Mines on combustion of coke and the reduction of iron oxides in the blast furnace. Previous study of the combustion zone of the iron blast furnace, by means of a series of gas samples taken through the tuyeres across the hearths of 13 blast furnaces, showed that the combustion of the coke in the blast-furnace hearth is complete at a distance of 32 to 40 in. from the nose of the tuyere, measured horizontally toward the centre of the furnace. The results of this previous work show that practically all of the oxygen disappears at a distance of approximately 30 in. from the nose of the tuyere.

In order to determine the height at which oxygen is found in a vertical direction above the tuyeres—it had been suggested that the combustion zone turned upward near the tuyere—and to obtain comparisons with the samples taken at the Bureau of Mines experimental (five-ton) blast furnace at Minneapolis, the Bureau extended the gas sampling on a commercial furnace to a number of planes between the tuyere level and the stock line. The sampling was conducted on a 300-ton furnace, making foundry iron, operated by the Central Iron and Coal Co., at Holt, Ala. The furnace was smelting Southern red and brown ores and nodules from purite sinter. The method of sampling the gases was similar to that described by Perrott and Kinney (Combustion of coke in the blast-furnace hearth. *Trans. Inst. Min. and Met. Engr.*, Vol. 69, 1923, pp. 543–584). A water-cooled tube was used, and the samples were collected over mercury and analysed in a modified (Burrell) type of Orsat apparatus. Samples were collected in each plane at intervals of approximately 4 in. between the inwall and the centre of the furnace. The planes were repeatedly sampled on each day of sampling and on several different days.

The averaged results of the analyses of gas samples from planes 1 to 5, from the lowest upward, are given on the following page.

Discussion of Results

Only a trace of oxygen (0·4 per cent. or less) was found at any point in the line of sampling on plane 5. This indicates that the oxygen has been consumed in the process of combustion by the time it reaches a plane 27 in. above the centre line of the tuyeres. The penetration of the combustion zone in a vertical direction is practically the same as that in a horizontal direction at the tuyere level. On the tuyere plane the oxygen practically all disappears at a distance of 30 in., measured on a horizontal line drawn from the centre of the nose of the tuyere to the centre of the furnace at the tuyere level. The increase in CO above the theoretical amount, 34·34 per cent., which may be obtained from the combustion of air and carbon, in the centre of the furnace at the hearth level and the level of plane 5, is due, in order of importance, to the following three factors: (1) restricted circulation of gases in the centre of the hearth area, (2) so called direct reduction, and (3) formation of cyanides.

Plane 4, which is 19 ft. 3 in. above the tuyere plane, might be taken as a dividing line in the furnace, for most of the reduction takes place above it. Below this plane the gas and the necessary heat for the reactions are produced and the remaining oxygen is removed from the charge. A uniform gas composition exists at plane 4. The CO content of the gases is approximately that of bosh gas—34·0 per cent. CO and 66·0 per cent. N_2. No free O_2 is found on the plane, and analysis shows but little CO_2. Since the reduction takes place in the lower part of the furnace, the gases at plane 4 contain a slight excess of O_2 in combination with C. The excess O_2 in the gases at this plane is of course present as CO, due to the temperature.

Gas Sampling at Plane 3

Experience has shown that gas samples taken at the inwall may or may not have the same composition from day to day, also that such samples do not represent conditions present a short distance from the inwall and by no means resemble those at the centre of the furnace. In order to obtain comparable and representative results, it was necessary to take numerous duplicate samples on any radius tested. These samples have been duplicated on one and several days, at times when the furnace was believed to be working normally. For a distance of 15 in. from the inwall the CO_2 increased rapidly. From this point to 50 in. there is a slight falling off, and a more rapid decrease as the centre of the furnace is approached. The CO_2 shown is a measure of the reduction taking place between planes 3 and 4. Part of the CO_2 found here is due to the calcination of limestone; the amount will be discussed later. The high CO_2 near the inwall clearly brings out the fact that reduction is not taking place uniformly across the plane. The composition of the gases at the centre of plane 3 is approximately the same as that at plane 4, also that the highest CO_2 on the plane is found near the wall and directly over the combustion zone.

As regards plane 2, the curves obtained by plotting volume per cent. of nitrogen, carbon monoxide, and carbon dioxide against distance from inwall have the same characteristic shape as those for plane 3, which is 11 ft. 7 in. below plane 2. The CO_2 curve indicates that the gases containing most CO_2 are near the inwall. At a point 40 in. from the inwall the CO_2 content of the gases diminishes rapidly until the centre of the furnace is reached. The CO_2 content of the gas at the centre of the plane, like that at the centre of plane 3, is low. At plane 2 numerous individual samples making up the averages shown contained 18 and 19 per cent. CO_2, and the table shows that much of the gas on the plane contains 12 to 15 per cent. CO_2. This is considerably higher than the CO_2 content of the top gas, which contained 9·9 per cent. CO_2. Obviously, it would be desirable if the gas emerging from the entire plane contained 12 to 15 per cent. CO_2.

Gas Sampling on Plane 1

The results of gas sampling on plane 1 are similar to those found on planes 2 and 3. CO_2 is highest at points less than 40 in. from the inwall. The gas at the centre of the furnace has approximately the composition of bosh gas. This would indicate that part of the gas emerging through the centre of the furnace has the same composition as the gas at the elevation of plane 4, and is doing little in the work of reduction. This is further substantiated by the results of a series of gas samples which were taken above the stock at the centre of the stock line. The gas was collected at a point very close to the top of the stock, so that the gases emerging from this part of the column had little opportunity to mix

with the gas emerging from other portions of the stock line. The analysis of 12 samples taken on two days follow: CO_2, 1·8 per cent.; O_2, none; CO, 34·4; H_2, 1·7; and N_2, 62·1 per cent. As the top gas contains 9·9 per cent. CO_2, and the gas at the centre of the plane at the stock line contains 1·8 per cent. CO_2, and near the wall 12 to 15 per cent. CO_2, it is obvious that the top gas is made up of a mixture of gas of various compositions emerging from different points on the stock line. It would be desirable to have throughout the column a gas composition which increases uniformly in CO_2 content as it approaches the stock line; for example, this particular furnace would then have a top gas containing 12 to 15 per cent. CO_2 in place of 9·9 per cent. CO_2 with a resultant lower coke consumption.

Causes of Non-Uniformity in Gas Composition

The non-uniform composition of the gas, as shown by the samples obtained on the various planes, is due to a combination of several causes: (1) A difference in porosity in the stack column; (2) segregation of iron oxides in the outer portion of the column; (3) unequal stack flow; and (4) unequal gas flow. In practice, the charge dumped from the bell to the stock line takes a shape similar to that of a V. The coke is probably distributed fairly uniformly over the area of the stock line, while the iron ore falls nearer the wall of the furnace. Large pieces of ore and coke may tend to roll to the centre of the V. The method of charging employed causes two conditions: (1) a more porous and open charge in the centre of the shaft, and (2) a segregation of iron oxide near the walls of the furnace. It would seem advisable to keep the charge a little more dense on the walls, thus reducing gas flow and protecting the wall. The more porous centre leaves, however, a path of lower resistance through which a freer passage of gases may take place, thus causing non-uniformity in the gas flow. The method of charging, which allows the greater part of the ore to fall near the wall, will result in gases of low CO_2 content emerging from the centre of the shaft.

Conclusions

This investigation of a 300-ton furnace in operation proves the following:

1. The oxygen of the blast has been consumed, in the process of combustion, at a point 27 in. above the centre line of the tuyeres, and the penetration of the combustion zone in a vertical direction is equivalent to that in a horizontal direction at the tuyere level.

2. The composition of the gas across a plane 20 ft. above the tuyere level is constant. The excess oxygen therein is due to reduction taking place in the bosh.

3. As the composition of the gas at plane 4 is constant, the abnormal gas composition shown in the centre of the hearth near the tuyere level is a local condition. This is due to a combination of three factors, these being, in order of importance: (*a*) restricted circulation of gases in the centre of the hearth area; (*b*) so-called direct reduction; and (*c*) formation of cyanides.

4. The uniformity of gas composition at plane 4, 20 ft. above tuyere level, does not indicate uniformity of flow.

5. Analyses of samples at planes 3, 2, and 1 which were approximately 41, 53, and 63 ft. above the tuyere level, show unequal gas composition across the planes. It is pointed out that this is due to the effect of four factors: (*a*) a difference in porosity in the stock column; (*b*) segregation of iron oxides in the outer part of the column; (*c*) unequal stock flow; and (*d*) unequal gas flow.

6. The results indicate that better practice with lower coke consumption might be obtained if operation could be so maintained that the gas composition on any plane above No. 4 would be uniform in CO_2 content, and also so maintained that the CO_2 content of the gases would increase with distance from the hearth level. This condition will exist if the materials are so arranged in the stack that the composition of the charge is uniform throughout the column. It then follows that the flow of gas and stock in the column must be maintained uniformly.

ANALYSES OF GAS SAMPLES FROM PLANES 5, 4, & 3.

Number of samples.	Distance from inwall, inches.	Per cent. by volume. CO_2	O_2	CO	H_2	N_2
Plane 5, 61 ft. 1 in. below stock line and 2 ft. 3 in. above tuyere level.						
16	0	0·8	0·3	33·6	0·7	64·6
14	4	0·3	0·3	30·6	0·4	68·4
16	10	1·4	0·1	28·1	0·5	69·9
15	15	3·0	0·1	25·0	0·4	71·5
7	20	7·8	0·1	16·3	0·5	75·3
8	25	7·5	0·4	18·6	0·7	72·8
6	30	1·9	0·1	30·2	0·3	67·5
7	36	0·3	0·3	32·9	0·1	66·4
12	40	0·7	0·3	33·4	0·5	65·1
8	46	0·2	0·1	42·2	0·4	57·0
12	52	0·0	0·0	44·5	0·5	55·0
12	58	0·0	0·0	46·8	0·6	52·6
16	66	0·0	0·0	50·4	0·6	49·0
15	74	0·0	0·0	51·6	0·5	47·9
11	80	0·0	0·0	52·0	0·7	47·3
20	84	0·0	0·0	52·6	0·7	46·7
10	90	0·0	0·0	53·6	0·7	45·7
Plane 4, 44 ft. 1 in. below stock line and 19 ft. 3 in. above tuyeres.						
139 average		1·1	0·0	33·6	0·8	64·5
Plane 3, 21 ft. 7 in. below stock line and 41 ft. 9 in. above tuyeres.						
18	0	9·0	0·0	28·0	1·8	61·2
6	2	5·4	0·0	31·5	1·3	61·8
11	8	10·7	0·0	27·5	1·6	60·2
13	12	9·2	0·0	28·5	1·7	60·3
10	14	9·3	0·0	28·6	1·6	60·5
16	16	12·0	0·0	26·0	1·8	60·2
6	20	12·3	0·0	26·2	1·6	59·9
7	26	11·9	0·0	25·8	1·4	60·9
7	32	10·1	0·0	26·8	1·5	61·6
10	38	10·6	0·0	27·6	1·5	60·3
9	44	10·8	0·0	27·4	1·7	60·1
7	50	8·5	0·0	26·6	2·5	62·4
7	56	8·1	0·0	30·2	1·6	60·1
6	65	7·2	0·0	31·2	2·0	59·1
7	70	4·9	0·0	33·2	2·0	59·9
8	74	3·0	0·0	34·1	2·2	60·7
7	80	2·4	0·0	36·7	1·9	59·2
5	86	1·5	0·0	34·1	3·1	61·3
1	89	0·9	0·0	35·2	0·5	63·4
4	100	1·2	0·0	36·8	1·7	60·4

ANALYSES OF GAS SAMPLES FROM PLANES 2 & 1.

Number of samples.	Distance from inwall, inches.	Per cent. by volume. CO_2	O_2	CO	H_2	N_2
Plane 2, 10 ft. below stock line, 53 ft. 4 in. above tuyere level.						
17	0	15·1	0·0	22·2	2·1	60·6
8	3	13·0	0·0	24·4	2·0	60·6
7	9	13·2	0·0	23·9	1·9	61·0
9	15	13·4	0·0	23·8	1·8	61·0
10	21	13·8	0·0	24·0	1·6	60·6
8	27	14·2	0·0	24·6	1·9	59·4
9	33	13·9	0·0	24·0	1·9	60·2
9	39	13·1	0·0	25·1	1·6	60·2
6	45	12·3	0·0	26·2	1·4	60·1
7	51	11·4	0·0	26·5	1·5	60·6
3	57	8·1	0·0	30·2	1·6	60·1
6	63	8·0	0·0	29·7	1·3	61·0
8	69	7·1	0·0	30·7	1·5	60·7
5	75	5·9	0·0	31·9	1·5	60·7
6	81	4·9	0·0	32·6	1·7	60·8
7	87	5·9	0·0	32·1	1·7	60·3
6	93	5·5	0·0	31·7	1·4	61·4
3	99	4·3	0·0	33·6	1·6	60·5
3	105	4·6	0·0	33·6	1·7	60·1
Plane 1, 3 ft. below stock line and 63 ft. 4 in. above tuyere level.						
11	0	10·6	0·0	26·5	1·7	61·2
3	2	11·8	0·0	27·0	1·6	59·6
4	7	10·5	0·0	26·3	2·1	61·1
8	12	11·9	0·0	24·7	2·1	61·3
6	18	11·5	0·0	26·6	1·8	60·1
8	24	11·3	0·0	25·8	1·9	61·0
7	30	11·3	0·0	26·8	1·9	60·0
22	36	12·0	0·0	24·7	2·5	60·8
10	42	10·4	0·0	27·0	1·7	60·9
3	48	9·2	0·0	27·8	1·6	61·4
6	51	9·9	0·0	27·3	1·5	61·3
6	54	6·9	0·0	30·7	1·5	60·9
15	60	7·5	0·0	30·0	1·7	60·8
12	66	4·8	0·0	33·0	1·5	60·7
11	72	2·5	0·0	35·2	1·5	60·8
11	78	2·1	0·0	35·1	1·6	61·2
11	86	2·0	0·0	35·4	1·6	61·0
10	92	2·8	0·0	35·6	1·5	60·1
3	96	2·5	0·0	35·9	1·4	60·2
Top gas analysis.						
44	—	9·9	0·0	28·1	2·0	60·0

A Survey of Metallurgical Industry

By Sir Robert A. Hadfield*

THE conditions of business generally during the past year were most unsatisfactory. This company suffered like others from very severe cutting of prices which existed throughout the whole of the year. No firm is perfect, but at any rate we have tried to carry out a policy of "live and let live"; also as far as possible not to undertake work at less than cost price. I know of one firm in which we have subsidiary interests. Its managing director is a particularly hard worker, and in regard to a certain contract he sat up several nights scheming out how to cut down his costs to the lowest possible figure. He presented his tender and was finally told it was rejected because another firm, one of his competitors who had paid no dividend for some time, finally undercut him on a contract having a total value of about £44,000 by no less than £7,500. The tenderer must have known that his price meant a dead loss, if their costing system was in order, of at least £5,000 or £6,000. With firms who carry on business of this character no one has any sympathy when they get into low water. Some of our competitors would be wise if they did not quote below cost. To obtain orders under cut conditions means that much work is of no value from the profit point of view.

On this question of competition the world is in a powerless condition at present. One reads of Belgium underselling British steel in South Wales. In the United States Belgian and German pipe founders are laying down pipes in American cities. British pig iron is going to the United States in quite large quantities, and the same thing is happening in other directions. Our new electrically driven rolling mills, both small and large, are getting into their stride, but in bad times like the present progress is slow, and meanwhile we have to carry this burden. The importance, however, of a complete equipment of rolling mill, forges and presses for a modern steel works catering for alloy steels and other special steels cannot be over-estimated. Our policy is sound, and will in the long run repay us.

Machinery Energy to Aid Workers

Not long ago I saw a statement that at the elbow, so to speak, of every workman in the United States was placed 1½ horse power; that is, in addition to his human energy, much use was made by him of "machinery energy." As the point seemed quite an interesting one I had an analysis made of the power available at our East Hecla and Hecla Works including electrical, steam and hydraulic power :—

Number of men employed	4,300		
Actual manufacturing machinery exclusive of rolling mills and presses		19,500 h.p.	
Average per man			4·5 h.p.
Transport and lifting appliances..		9,900 h.p.	
Average per man			2·3 h.p.
Total horse power exclusive of rolling mills and presses.....		29,400 h.p.	
Average per man.....			6·8 h.p.
Total horse power including rolling mills and presses		53,500 h.p.	
Average per man.....			12·4 h.p.

About one quarter of the above is steam power generated by ourselves, the other three-quarters being electric power obtained from the Sheffield Corporation supply. The only fault we have to find is that the charges made are still far too high in times like the present. We already make payments for rates and taxes amounting to from four to six times the amounts prevailing before the war. If the Corporation demand high rates and taxes they should supply electric energy to large users at absolutely cost price. It will be seen that the worker at Hadfields is not short of power, and that we compare most favourably with the latest and best American works. Unfortunately in one sense there is too much horse power available, that is, we want to distribute over more workers this total available power. In the past it has been argued by the less far sighted trade union leaders that increased use of machinery meant less distribution of employment. This has proved to be a fallacy. There never was a better example of this than the high output per man during the war, showing the effects of specialisation.

Exports of Iron and Steel

In view of the importance of our exports of iron and steel, during the month of March this year the production of steel alone in the United States amounted to the very high figure of 4½ million tons, or at the rate of 54 million tons per annum. The following statement, which can be absolutely relied on, shows our position in relation to that of other countries in exports of iron and steel in thousands of tons :—

	1913		1924		1925	
	tons	%	tons	%	tons	%
United Kingdom .	4,969	34	3,851	39	3,731	30
United States ...	2,907	20	1,711	17	1,685	13
Germany	6,301	42	1,559	16	3,212	26
France	628	4	2,818	28	3,861	31
	14,805		9,939		12,489	

It will be seen that before the war the exports of iron and steel of these four leading countries totalled nearly 15 million tons. The leading position was then held by Germany, who exported 6¼ million tons, as against our 5 million tons; the United States slightly under 3 million tons, with France very little more than ½ million tons. For the year 1925 the total exports are not far away from the pre-war figures, these amounting to 12½ million tons; this is surely a hopeful sign. It is satisfactory to note that the United Kingdom last year exported 3¾ million tons; France is slightly above this; Germany now exports only 3¼ million tons; and the United States has dropped to little more than 1½ million tons. These figures give some assurance that Great Britain has not gone down the hill; in fact, in 1924 our share was 40 per cent. or in figures 3,800,000 tons of exports. The leading factor in the change is our great ally, France, who is rapidly coming to the front. This is due partly to the newer and better position she has obtained as a result of the war, including the rightful restoration to her of her old provinces Alsace-Lorraine.

Business Conditions

Taking a broad survey of general conditions, I was much struck by a recent statement that during the last quarter 460 companies, after payment of debenture interest and other charges, earned a net profit of 51½ millions, this being an increase of 7·6 per cent. over the profits earned by the same companies in their preceding financial year. On analysing the figures, however, the largest increase in this total sum was from a group of 41 rubber companies. No fewer than 25 iron, coal and steel companies showed no increase in profit but a decline of 32 per cent.; six shipping companies a decline of 11·6 per cent. and 25 textile concerns a decline of 6 per cent. Whilst it is satisfactory to find some sections of the community benefiting, one cannot but express the hope that the metallurgical and mining industries will before long get their share; they have had a long and dreary bad time.

In view of the general world unrest I feel that some reference should be made to the present European financial conditions. There are two main factors, both of them out of the control of the man in the street. The first is the enormous recent war expenditure of capital in actual money and physical products. The cost of the world struggle was probably sixty to seventy thousand millions sterling, something like eight to ten times our National Debt.

To add to the difficulties of the financial situation, our friends across the water in the great American Republic have adopted a financial policy which has been ill-fitted to help the serious position of Europe. They entered into the war because they saw that the cause of liberty and justice was at stake. They have benefited immensely from the result of the war and obtained a position of security which without doubt sooner or later would have been attacked by the Germanic Confederation. In due time they will see that the policy of extracting the pound of flesh will not in the long run benefit even themselves, and only add to the trouble of Europe, including our own country.

**Abstracted from the Chairman's address at the annual meeting of Hadfields, Ltd., Sheffield.*

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institute of Metals Autumn Meeting

THE final programme of the autumn meeting of the Institute, which will be held this year in Liége from September 1 to September 4, will be issued shortly. According to the preliminary programme, Dr. W. Rosenhain, F.R.S., will deliver the Autumn Lecture; various papers will be read and discussed; works will be visited; and there will be a civic reception. This meeting will be the first to be held on the Continent since the Ghent meeting in 1913.

Heterogeneity in Steel

AT the meeting of the Iron and Steel Institute, held on Thursday and Friday (postponed from May) the main items of interest were the report of the special committee appointed by the Council to inquire as to the heterogeneity of steel ingots; a paper by Dr. Rosenhain and his colleagues at the National Physical Laboratory on "The Effect of Mass in the Heat-Treatment of Nickel Steel"; and a paper by Mr. J. H. S. Dickenson on "The Distribution of Silicates in Steel Ingots." The last paper may be taken as being, in a measure, complementary to the report of the committee on heterogeneity (of which Mr. Dickenson was a member), and it is a piece of work marked by the thoughtful care which Mr. Dickenson has taught us to associate with his researches. The report and the paper on silicates are, however, of profound importance, and to none more so than to engineers. The latter have always been suspicious of steel. They are in a majority on the various sub-committees of the Engineering Standards Association, and it may well be believed that they have been, in the main, responsible for the stringency of the specifications, chemical and physical, which that body, with a praiseworthy insistence on "Safety first," has always imposed on steel manufacturers. The report and Mr. Dickenson's paper show how well founded the suspicions have been, and how necessary are the restrictions devised by the Association. It says much for the public spirit of the Institute Council that the report has been published. It is a document the *bona fide* character of which is incontestable. It is, at the same time, a somewhat serious indictment of steel.

What is Steel?

IT was at one time fashionable to consider that mild steel was chiefly to be distinguished from wrought iron by the fact that it was free from slag. Shocking examples of wrought iron, in microscopic sections duly multiplied *n* diameters, in which streaks of slag, woefully elongated, stood revealed, in contrast to the homogeneous and slag-free innocuity of mild steel, were exhibited triumphantly to bear testimony to the higher quality of the cheaper material. Much research work, which Mr. Dickenson's investigations confirm and endorse, show that this distinction does not, in fact, hold good. "Sonims," to use the ugly word introduced in America, abound in steel as in iron. There must have been something wrong with the photomicrographs which masked those features. Solid non-metallic inclusions are not, however, either the only or even the worst of the factors which make steel an essentially heterogeneous material. Blowholes, oxide particles and segregates combine to detract from its purity, its homogeneity, and, it is to be feared, from its general trustworthiness. The committee have not thought it within their province to make recommendations for the avoidance of these inherent defects. The conclusion, painful though it be, is that they are unavoidable, inseparable from the processes of manufacture, and not wholly to be eliminated in the final result. The assumptions to be drawn from the reading of the report and from the paper by Mr. Dickenson are serious ones. Steel may, or may not, serve for a given purpose. Its use would appear invariably to be accompanied by some element of risk, some steel part or parts may sometimes fail, suddenly, and from some apparently obscure cause. The cause is no longer obscure, nor are the reasons for its occurrence. We go one stage further back in the elucidation of causes. Sudden failure is due, nearly always, to some flaw, microscopic perhaps in its origin, but leading, eventually, to obvious, assertive and macroscopic breakdown. The report takes us back yet another stage. The cause of flaws is heterogeneity. And heterogeneity is inseparable from steel.

It is impossible so to diffuse impurities as to render their presence innocuous. Even if it were possible to do so, the resulting material would still be heterogeneous, and therefore liable to behave differentially, in parts, when subjected to stresses. In practice, not only is it impossible to diffuse impurities evenly throughout a mass, but it is equally impossible to prevent selective segregation, and thus a degree of heterogeneity which differs and varies dangerously from part to part. The only way to secure homogeneity is to have a pure material to start with. Steel is never pure; if it were it would not be steel. Wrought iron is never pure. It may be, and often is, purer than the best mild steel, and far purer, of course, than a steel which is a typical steel. It always, however, contains slag. Hence, from this cause, it, too, lacks homogeneity. It possesses advantages from the point of view of trustworthiness, and also from the fact that it corrodes less than mild steel, owing to its relatively greater purity. But this is a matter of degree only. The initial fact remains, that wrought iron, too, is heterogeneous.

Pure Iron and Homogeneity

IT is only within comparatively recent years that a pure, and therefore homogeneous, material has been available, in commercial quantities, for the many purposes for which mild steel or wrought iron has hitherto been used. Its intrusion caused great confusion in the nomenclature of iron and steel. It was, by nature, a hybrid, and could not be made, forcibly, to fit the niche which metallurgists tried to make for it. It was pure iron, yet it was made by a process which had many resemblances to that by which openhearth steel was made. For that, insufficient, reason the framers of definitions insisted that it was steel. This was an exceedingly illogical and arbitrary proceeding. The material in question was, of course, nothing of the kind. It was pure iron. Hitherto, only the two impure ferrous metals, wrought iron and steel, apart from the extremely impure product, cast iron, had been known to commerce. The new material, to which, for convenience, the name "Armco" ingot iron had been assigned by its inventors, occupied a place apart. It was an anomaly. It came, however, to stay, and there is little doubt that the report of the Committee on the Heterogeneity of Steel Ingots will serve to focus renewed interest on "Armco" ingot iron. It does not suffer from heterogeneity, and very important considerations are involved in that fact. For one thing, this material, which is a distinct variety of iron in the same sense as electrolytic iron, or wrought iron, or openhearth steel, or crucible steel are distinct varieties, is, from its very homogeneity, far less prone to corrosion than the varieties enumerated. Modern views of corrosion concur in ascribing it largely to localised galvanic action, due to the differential action of the impurities which occur in ordinary commercial iron and steel. In ingot iron there is no such differential action set up; there are no impurities to act as so many "elements" and cause electrical currents at the expense of each other and of the surrounding material. The most important point, however, in regard to ingot iron is its freedom from the causes which lead to failure. There is nothing to segregate; no slag, and no other "sonims." When safety first is a consideration, ingot iron finds widespread and legitimate justification for its adoption. Its homogeneity renders it, moreover, an admirable base for tinning, plating, enamelling, painting, and other protective devices. They adhere better to the surface, and blistering and pinholing do not, in these circumstances, occur.

Platinum in South Africa

SINCE the revolution in Russia, there has been a world shortage of platinum. The metal is an easy one to produce, given the means of securing the high temperatures required, and its metallurgy is attended with no greater difficulty than that of employing suitable refractories. Its sources, although like gold, widely scattered, are meagre, and it is interesting therefore to hear of the discovery of the metal, in somewhat novel circumstances, in South Africa. At a recent meeting of the Chemical, Metallurgical and Mining Society of South Africa specimens were shown, with the permission of the Central Mining Rand Mines Group, by Mr. R. A.

Cooper, of metallic platinum obtained from dunite, found, in association with chromite, in the Onverwacht Pipe. The find is, it is believed, unique from a metallurgical and mineralogical point of view. The chromite in question had a composition corresponding with Cr_2O_3 3 (Fe, Mg) O and contained 43 per cent. of Cr_2O_3, thus differing considerably from the more frequently occurring Cr_2O_3, FeO, the "ideal" mineral from the point of view of producing chromium. The replacement of some of the iron by magnesium is common enough. What is far less common is its being so intimately associated with dunite, a rare species of olivine. In the specimens referred to, the dunite inclusions contained as much as 100 or more dwts. to the ton, and, it was suggested, appeared to have acted as collectors of platinum. It is an old adage that there is always something new out of Africa, and private information leads to the belief that much platinum may eventually be found in that country. Alluvial platinum in rich deposits is in course of being proved elsewhere, and, if more is forthcoming from the Rand, Africa may be able before long to take the place of the Urals as a source of the increasingly valuable metal.

Atomic Hydrogen Arc Welding

SOME results recently obtained in America by Langmuir and others promise to have very important effects on methods used in welding. By directing a stream of hydrogen into an arc struck between tungsten electrodes there is produced a flame of atomic hydrogen, of temperature higher than that of the oxy-acetylene flame. In principle the development of this temperature depends on the recombination of the hydrogen atoms, since the hydrogen molecule, as shown by Langmuir some years since, has a very high heat of dissociation, and consequently the atoms develop great heat on recombination. In a very convenient type of welding torch based on the above principles the electrodes are mounted at a convenient angle to one another and are adjustable so that they can be brought into contact at a point exposed to a blast of hydrogen from two or more orifices. By means of this blast the atomic hydrogen is blown out of the arc and forms a flame which is used for welding purposes. Moreover, the hydrogen blast sweeps the heated electrodes and the parts welded, thus preventing oxidation. For direct current the arc may be stabilised by a series resistance, good results being thus obtained with a 250 volt supply current. With alternating current the arc, with greater efficiency, may be stabilised by reactance. With cold electrodes the striking of the arc necessitates a voltage of 320 (a.c.). The torch works on 20 to 70 ampères, which is sufficient for work one-eighth to one-half inch in thickness; 20 to 30 cubic feet of hydrogen per hour is required for ordinary welding, and for welds up to one-half inch in thickness less than a 1 lb. pressure per square inch. Electrode consumption is small. The fan-shaped arc of narrow section obtained with two electrodes will, with a current of 20 ampères or more, melt an iron rod, of diameter one-quarter of an inch, at a distance of 2 in. For welding, the torch is brought up to the metal so that the lower portion of the arc is just in contact with the metal. The torch should be inclined at 45° to the metal surface so that the hydrogen blast passes over the molten metal in the opposite direction to the movement of the torch along the weld. Hence rapid heating and melting occur, but cooling is sufficiently slow to permit escape of the dissolved gases, which is important, as gas pockets and inclusions are avoided. Equal parts of hydrogen and nitrogen give good welds, but greater voltage is required than with hydrogen alone. Illuminating gas (with graphite electrodes) gives ductile welds on copper, but porous welds on steel. Graphite electrodes with hydrogen alone give non-porous welds on iron, but the electrodes are rather rapidly consumed. Aluminium and nickel, alone and together, and chrome nickel alloys, may be successfully welded by the atomic hydrogen process. Using hydrogen alone, good welds can be made on low carbon steels up to one-half inch in thickness without additional metal, but on welds with thickness greater than this filler metal may be necessary. Tests were made on strips of cold-rolled steel three-quarters of an inch wide and 14 in. long, cut from sheets having butt welds in the centre with a small amount of Armco filler. It was found that the softest area was within a quarter of an inch of the boundaries of the weld.

Large Welded Trusses Under Test

A SERIES of four roof trusses was tested to destruction at the Engineering Laboratory of The Linde Air Products Co., Buffalo, New York, this being the culmination of a year's study of the application of oxy-acetylene welding to the fabrication of steel structures. As a first step, studies were made of various types of joints in various kinds of steel shapes. A few of the most promising schemes were then built into typical truss intersections, and proper jigs built to load these joints to destruction. Unit stresses for weld metal in tension, compression and shear were determined by this means. The variety of joint known as the "plate insert joint" was shown to have marked advantages.

Next a 40 foot roof truss was designed and built of conventional angle-iron sections, using the information gained by this preliminary work. In testing, very elaborate framework was necessary to give the upper chord of the truss the lateral support it would receive when placed in a building. Platforms were hung from each panel point and loaded with pig iron. At definite increments of load the stresses in each member were measured by an extensometer. At double the design load, each welded joint was vigorously pounded with a heavy hammer. At 3½ times the design load, the truss failed by buckling in the upper chord—no distress at any welded joint was in evidence. At the time of failure the truss designed for 21,000 pounds load was carrying 75,000 pounds of pig iron.

Results of Tests

HAVING thus demonstrated the soundness of the underlying methods, four trusses were prepared for comparative test. One was designed and built by a leading structural shop; another was welded by the Linde Co., using members of the same size from the same mill rolling; the third was designed to have the same strength as the riveted truss, but since the oxy-acetylene welded joint allows a better placement of the metal, it was materially lighter in weight. A fourth truss was welded of tubular sections.

A summary of the final result is as follows:—

Style.	Weight. Lb.	Total load at failure. Lb.
Riveted Truss.....	1,161	62,000
Welded Truss of equal weight	1,150	72,000
Welded Truss of lighter weight	1,079	70,000
Welded Truss of tubular sections ...	916	63,000

All trusses failed by buckling of the top chord, a compression member. In no instance were there any signs of distress at a joint. These tests were made under observation of engineers from the Pittsburgh Testing Laboratory, and in the presence of several independent observers.

A New Alloy of Steel

A NEW alloy of steel, known as "Era/A.T.V," and capable of being heated to very high temperatures without any lasting effect on its properties, has been developed at the works of Hadfields, Ltd., of Sheffield. According to Sir Robert Hadfield, who has been chiefly responsible for the preparation of the new alloy, search had been made for years for a substance which would endure the terrific stresses and high temperatures occurring in the most efficient engineering processes, and the new steel alloy appears to solve the problem, since even when subjected to oxidising flames it does not scale at temperatures of 800° to 900° C. It is said that the new alloy has already been successfully incorporated in many engineering plants.

Tables of Brinell Hardness Numbers

THE British Engineering Standards Association have recently issued standard tables of Brinell Hardness Numbers (Publication No. 240, 1926). The tables are accompanied by recommendations in regard to the accuracy of the apparatus to be used for the test, the preparation of the test specimens, the magnitude and application of the load, and the method of specifying the hardness. It is hoped in a later edition to include a specification for the hardness of steel balls used for Brinell testing. Copies of this new publication may be obtained from the British Engineering Standards Association (Publications Department), 28, Victoria Street, London, S.W.1, or from the publishers, Crosby Lockwood and Son, 7, Stationers' Hall Court, London, E.C.4, price 1s. 2d., post free.

Trade, Commerce, Finance: The Month in Review

From Our Northern Correspondent

THE course of events has not justified the forecast made last month: the coal stoppage has taken place and still continues. Since the breakdown of negotiations between the owners and the men there has been an attempt on the part of the Government to induce a settlement by the offer of the continuance of the subsidy to a limited amount, but that offer expired on May 31. Now that this avenue is closed, we fear there is nothing to look forward to but a long stoppage, unless legislation is passed to put an end to it. The general strike was an attempt by the whole Trade Union movement to force on the Government and on the nation a settlement which would be in favour of the miners, but it was a total failure as far as that object was concerned. Nevertheless it has not been without definite results, both good and bad. The bogey of a general strike has been laid. The experience has shown that neither any one of nor all the sections of organised labour can withstand the quiet, resolute action of public opinion rallied in support of constitutional government.

General Strike and Coal Strike

While it lasted, the general strike completely overshadowed the trouble in the coal industry, but as soon as it was over, the country came back to a realisation of the essential difficulty with which it was faced and which was no nearer solution. Indeed, the failure of the general strike will probably have the effect of prolonging rather than shortening the coal stoppage. The miners can be very obstinate if they choose, and the knowledge that they have to fight alone, with no hope of gaining the victory, may have aroused in them a stubborn determination to continue the struggle to the utmost limit. It may be that they are still hoping for Government interference by legislation, hence their resolve to hold out. On the other side the owners are not averse to a long stoppage, if at the end of it they can feel that the matter at issue has been settled in such a way that they can look forward to a prolonged period of activity undisturbed by labour disputes. If that can be achieved they consider that a few months' stoppage is not too big a price to pay for it. The owners make no secret of their desire to fight the matter out to a finish, free from Government interference of any kind.

Effect on Iron and Steel Trade

The stoppage has laid a heavy hand on the iron and steel trade. Practically all the producing departments are closed down, and even the rolling mills which are now able to keep going on their stocks will soon come to the end of their resources. The present almost complete stoppage of the steel works means an enormous loss to the industry, and this loss is mounting up each day the settlement is delayed. There seems to be no escape from the evil fate which has pursued the steel trade for so long. The previous coal strike in 1921 caused incalculable loss to the steel works and considerably accentuated the depression which had then laid hold of the trade. Since then there has been a slow and painful struggle to get back to a position of stability, but that position has not yet been reached, although on more than one occasion hopes have been aroused that it would soon be in sight. These hopes had again become strong in recent months, and there was a definite upward movement, which would have been more pronounced had there been no industrial cloud on the horizon. There were good reasons for thinking that if a favourable settlement of the coal dispute had been reached without a strike there would have been a steady revival in the steel trade which would have enabled us to escape from the unsatisfactory position of the past few years.

Once again these expectations are disappointed, and the steel makers are faced with heavy losses accumulated day by day. Not only is there the loss of trade, but also the very heavy direct loss caused by the damage to the furnaces and other parts of a heavy steel plant which inevitably ensues on a long stoppage. It will take months to recover from this further handicap, and already in some quarters there is doubt whether recovery is possible. Nevertheless the spirit of optimism which has kept the trade alive so long still enables the steel makers to see the possibility that when the present trouble is ended, as it must be sooner or later, and particularly if it is ended in such a way that there will be no early recurrence of it, the promised and long expected revival will steadily set in. It may well be that coal prices will advance, but steel prices will also move upwards and the placing of orders which have been held back owing to the industrial uncertainty will enable the works to get busy and, we hope, keep busy.

Should Prices be Adjusted?

It would certainly be a good thing if the steel makers were to take advantage of the present position by putting steel prices on a proper basis. It is generally admitted that the present selling prices which have been agreed upon do not cover the cost of manufacture, to say nothing of the added cost of carriage to destination, and an attempt should be made to fix a level of prices which more nearly approximate the cost, and also include an average rate of carriage. There will be an accumulation of orders to be overtaken when the works resume, and the flow of new business will probably be sufficient to make the proposal feasible. Such a step will have to be taken; it is made more than ever necessary by the losses caused by the present stoppage, and unless it is done the outlook for some of the large plants is decidedly black.

There is naturally very little to say about market conditions during the present month. There is practically no business being transacted. The great majority of the producers of iron and steel closed down at the commencement of the general strike and have not since restarted. Some consumers have endeavoured to take this opportunity of fixing up forward contracts at the present low prices, but on the whole the attitude of the makers does not encourage this. One or two of the steel works are willing to book contracts, even at the prices in force before the strike commenced, but the majority are hesitating to make heavy commitments, and are asking an advance of anything from 2s. 6d. to 10s. per ton for forward contracts. This attitude is quite a reasonable one, and is based on the almost certain increase in the price of fuel and on the equally probable advance in steel prices generally which will follow the resumption of work. If there were complete agreement among the steel makers the position would be easier, but the fear of the action which may be taken by some of the works who are desperately anxious to secure orders to keep their huge plants economically busy is no doubt the reason why the individual firms are willing to take whatever business is offered now.

Many of the works are using this occasion to get rid of their stocks of finished material, as consumers are only too pleased to find stocks of plates and bars which they can bring in for the work they have on hand. Re-rollers are able to maintain output to a limited extent, but nothing like their ordinary capacity.

The production figures for April were not so bad, comparatively, when the Easter holidays are taken into account. The quantity of pig iron produced was 539,100 tons compared with 568,500 tons in March, and the number of furnaces in blast at the end of April was 147 compared with 151 on March 31. The output of steel was 661,000 tons compared with 784,100 tons in March and 597,600 tons in April last year.

South African Steel Industry

SOUTH AFRICA will shortly be producing steel from its native iron ore. The blast furnace at Newcastle is now complete, and big stocks of iron ore, coke, and limestone have been accumulated in readiness for the blowing in of the furnace, which has a capacity of 150 tons a day; operations will be continuous, and the monthly output will be between 4,000 and 5,000 tons. The bounty on pig iron production, sanctioned by the Union Parliament, is based on a minimum production of 50,000 tons per annum. Operations will, at first, be on a comparatively limited scale, but the enterprise is now assured of ample financial resources, and those who are associated with it feel confident that it has very great prospects of becoming a great success.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature published weekly in THE CHEMICAL AGE.

Tungsten Carbide

A MIXTURE of raw tungsten with 5–10 per cent. of thorium carbide and 3–5 per cent. of molybdenum is fused in the presence of carbon in an electric furnace, the crucible being closed to the air when withdrawn. The principal product is tungsten carbide. See Patent Application 248,336 (H. Lohmann, Berlin), having the International Convention date, February 24, 1925.

Treating Copper Ores

ACCORDING to a patent application by Verein für Chemische und Metallurgische Produktion, of Aussig, Czecho-Slovakia, sulphide ores containing copper, but low in lead and zinc, are roasted at a low temperature with regulated air supply, and the product subjected to magnetic separation. The non-magnetic fraction is leached to remove copper, and the magnetic fraction roasted again, with or without fresh ore. See Patent Application 248,349, having the International Convention date, February 26, 1925.

Platinum Metals

A PROCESS has been patented by L. D. Hooper, of Malvern, Worcestershire, for the separation and purification of platinum, iridium, osmium, palladium, rhodium, and ruthenium. Platiniferous substances are subjected to the action of carbon monoxide gas or a compound such as phosgene under such conditions of temperature and pressure, and in the presence of fluxes and catalysts to form the carbonyl compounds of the platinum metals. These compounds are volatilised or separated by washing with an organic solvent, and may be separated from one another by fractional distillation, differential solubility, or otherwise. The metal is obtained by heating. See Patent No. 250,726, dated March 6, 1925.

Precipitating Copper

In a patent specification by Orkla Grube-Aktiebolag, of Lökken Verk, Norway, copper is precipitated from solutions by brass scrap. If the solution contains copper and zinc, it is thus enriched in zinc, which is then precipitated electrically. See Patent Application 248,724, having the International Convention date, March 6, 1925.

Casehardening by Sodium Cyanide

IN regard to the notes on "Cyanide Hardening" which appeared in the last Metallurgical Section of THE CHEMICAL AGE, we have received a communication from the Cassell Cyanide Co., Ltd., commenting on the statements made by the author. In their handbook, "A Treatise on Casehardening and the Heat-Treatment of Steel by Sodium Cyanide," the company deal with the matter in detail and emphasise, among others, the following points. If low-carbon steel is immersed for some time in a bath of sodium cyanide of suitable temperature, the outer zone of the metal has its carbon content considerably increased, and on quenching in cold water becomes very hard. Before the elementary iron in a steel can dissolve carbon to a solid solution, a certain "critical" temperature must be exceeded. For practical purposes, the best temperature is just above the critical point, giving great velocity of action combined with economy in fuel and cyanide. For most machinery steels, the critical point of which is in the neighbourhood of 840° to 845° C., 850° C. is a suitable carburising temperature. The carburising action of cyanide is not sharp and sudden; penetration proceeds in the same manner as with solid carburising media. The cyanide process is very economical in industries faced with the necessity of case-hardening large quantities of small machine parts for depths up to one thirty-second of an inch. Cast iron pots should never be used in the operation, since, owing to its non-homogeneous nature, the metal becomes spongy under the action of the molten cyanide, which soon percolates through and destroys the furnace bottom. Even welded steel pots sometimes break down, owing to attacks by the cyanide on weak spots in the weld. For general work a circular flanged vessel of mild pressed steel is recommended. Oxidation by furnace gases is the chief cause of pot failure, and as a protective measure the outside of the pot may with advantage be subjected to the process of "calorisation." Moreover, the atmosphere of the furnace chamber should be neutral or reducing. Furnaces should be designed with a view to correct and complete combustion of the fuel and maximum thermal efficiency. The life of pots is materially shortened by the direct impinging or blasting action of the flame, which should be prevented. The pot should be heated by radiation from the chamber walls. At working temperatures, molten cyanide gives off white fumes, which, though irritating, are not poisonous, containing a comparatively small percentage of cyanide. However, it is advisable to carry off the vapour with a draught, by means of a hood fitted to the furnace.

Details of Working

In the case of the hardening of small parts in mass production, the immersion being for 15 minutes or less, cold charging chills the cyanide bath and complicates temperature control. The difficulty is avoided by preheating the machine parts to the carburising temperature, prior to immersion in the cyanide bath, in a bath of salt containing a little cyanide to prevent oxidation.

To facilitate operations, graphs have been drawn connecting the depth of case with time of immersion at various temperatures. From these the time of treatment for any desired depth of case may be read directly. As regards the effect of variation in the strength of the bath on penetration of carbon into the steel, it may be stated that the cyanide content of the bath influences the character rather than the thickness of the case. Experiments have shown that the higher the cyanide content of the bath, the greater the resultant hardness produced. Very favourable results are given by a bath containing 75 per cent. of sodium cyanide and 25 per cent. of other sodium salts. Baths of low cyanide content (for reheating purposes) may be prepared by diluting the high strength bath with sodium carbonate and sodium chloride.

As hardness is in direct ratio to cyanide content, the concentration of the bath must be maintained by regular feeding. It is here that pure sodium cyanide, 97/98 per cent., which owing to its low melting point is not economical for case-hardening, becomes very useful, since it may be conveniently employed as a regenerating agent.

Owing to the intimacy of contact with the steel, cyanide carburising yields very uniform results. There is also a valuable saving of time, as compared with solid carburising agents, since for many purposes the entire cyanide process occupies only twenty minutes. This and other reasons (such as the fact that in many cases heat treatment after carburising and quenching is found unnecessary) render the method a very convenient one.

Metallurgical Matters in Parliament

IN the House of Commons on Tuesday Sir B. Chadwick, replying to Mr. H. Williams, said that statistics published by the National Federation of Iron and Steel Manufacturers showed that there were 147 furnaces in blast at the end of April. He was unable to state the number of furnaces out of blast at that date, but at the end of December, 1924, the number in existence was 475, and seven were in course of erection. The monthly productive capacity of those which could normally be in blast at any one time was estimated to be about 1,000,000 tons, while the output in April was 539,100 tons. The imports of pig iron in April amounted to 32,365 tons, and the imports of iron and steel and manufactures thereof (including pig iron) amounted to 261,787 tons. In view of the diversity of the products included in this latter total, it was not possible to give a precise estimate of the quantity of pig iron required for their manufacture.

Contract for Manchester Firm

MESSRS. EDWARD WOOD AND CO., LTD., of Ocean Iron Works, Manchester, have secured the order from the Michelin Tyre Company for the erection of steelwork at their new site at Stoke-on-Trent. The factory when erected will cover an area of forty acres.

Sheffield Steel Magnate's Death

MR. J. T. BURGESS, a well-known Sheffield steel magnate, died on Saturday last from sleepy sickness. Mr. Burgess, who was sixty-one, had been ill only eighteen days.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—Compensated aluminium alloys. W. Kroll. *Metall u. Erz*, May (1), 1926, pp. 225-230 (in German).

Discusses the effect of the replacement of the constituents of duralumin by other metals.

Cementation of iron alloys with tungsten. J. Laissus. *Rev. Métallurgie*, April, 1926, pp. 233-242 (in French).

Metallic cementations and the covering of iron alloys with aluminium. J. Cournot. *Rev. Métallurgie*, April, 1926, pp. 219-232 (in French). Describes the industrial methods for the cementation of iron with aluminium and his investigations of the cementation of various steels.

An atomic picture of duralumin and its crystal structure. R. J. Anderson. *J. Franklin Inst.*, April, 1926, pp. 465-482.

Ageing of aluminium alloys. Part III. K. L. Meissner. *Metal Ind. (Lond.)*, May 7, 1926, pp. 439-440. Discusses its effect upon the electrical conductivity and chemical resistance.

Some properties of the alloys gold-silver-copper. L. Sterner-Rainer. *Z. Metallkunde*, May, 1926, pp. 143-148 (in German).

ANALYSIS.—Electro-analytical estimation of nickel in nickel steel, etc. W. Moldenhauer. *Z. angew. Chem.*, May 27, 1926, pp. 640-642 (in German).

The volumetric estimation of chromium and manganese with potassium permanganate in acetic acid solution. B. Reinitzer and P. Conrath. *Z. anal. Chem.*, No. 3, 1926, pp. 81-114 and Nos. 4-5, 1926, pp. 129-155 (in German).

BERYLLIUM.—Beryllium and its preparation. K. Illig. *Z. Metallkunde*, May, 1926, pp. 159-160 (in German).

CORROSION.—Corrosion of steels in the atmosphere. W. G. Whitman and E. L. Chappell. *J. Ind. Eng. Chem.*, May, 1926, pp. 533-535. Describes a rapid test for corrosion resistance.

ELECTRO-DEPOSITION.—Measuring polarisation and resistivity. H. E. Haring. *Brass World*, May, 1926, pp. 155-159. A simple method, especially useful for copper, silver and nickel plating, for determining these factors during electrolysis.

Studies on electro-plating. Part VI. Barrel-plating (*continued*). W. E. Hughes. *Metal Ind. (Lond.)*, May 14, 1926, pp. 457-459; May 21, 1926, pp. 475-477; May 28, 1926, pp. 497-498. Deals with the composition of solutions and the working conditions generally.

FURNACES.—Cyanide accumulation in the blast furnace. Part I. R. Franchot. *Blast Furnace and Steel Plant*, May, 1926, pp. 217-220.

IRON AND STEEL.—The hardening of steel: a review and some comments. Part II. W. T. Griffiths. *Metallurgist*, April 30, 1926, pp. 51-53. Deals with X-ray spectrographic examination.

Influence of heat treatment and carbon content on the structure of pure iron-carbon alloys. W. L. Fink and E. D. Campbell. *Trans. Amer. Soc. Steel Treating*, May, 1926, pp. 717-752. An X-ray study of steels; includes a bibliography relating to investigations on alloys other than steel.

Gases in electrolytic iron and their effect on its properties. *Metallurgist*, April 30, 1926, pp. 53-55.

Facts and principles concerning steel and heat treatment. Part VI. H. B. Knowlton. *Trans. Amer. Soc. Steel Treating*, May, 1926, pp. 781-792. This article deals with the factors causing distortion, warping and cracking.

Sheet steel—specification and inspection. L. N. Brown. *Blast Furnace and Steel Plant*, May, 1926, pp. 206-212.

Iron, carbon and oxygen in their mutual relationship. R. Schenck. *Stahl u. Eisen*, May 20, 1926, pp. 665-682 (in German). Discusses the equilibria between iron, its oxide and carbide, carbon oxides and carbon.

Nitrogen process for surface hardening. *Metallurgist*, April 30, 1926, pp. 60-61. A new method for imparting a hard surface to steel articles.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BUTLER (JNO.) AND CO., LTD., Leeds, iron manufacturers. Registered May 14, mortgage securing all moneys due and to become due, to the mortgagee, F. W. Paxton, Castle Works, Scarborough, builder, under a certain agreement; charged on a certain contract. *£50,000. April 5, 1926.

BUTTERLEY CO., LTD., coal and ironmasters. Registered May 14, £500,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £250,000, to Westminster Bank Ltd., as security for moneys due or to become due to the Bank; general charge. *£110,000. July 10, 1925.

GJERS, MILLS AND CO., LTD., Middlesbrough, ironmasters. Registered April 26, £25,000 debenture to Branch Nominees, Ltd., 15, Bishopsgate, E.C.; charged on land at Middlesbrough, also general charge. *£125,000. November 10, 1925.

HENDY HEMATITE IRON ORE CO., LTD., Pontypridd. Registered April 13, £500 debentures part of amount already registered; general charge. *£3,859. July 24, 1924.

PARLANTI (E. J.) AND CO., LTD., London, S.W., art bronze founders. Registered April 23, £14,000 debentures (secured by Trust Deed dated April 19, 1926), present issue £10,650; charged on property at Fulham, also general charge.

SHEEPBRIDGE COAL AND IRON CO., LTD. Registered May 5, £4,700 debentures, part of £750,000; general charge (except uncalled capital and certain property). *£531,950. October 12, 1925.

Satisfaction

MONDEGO VALLEY TIN SYNDICATE, LTD., London, E.C. Satisfaction registered April 21, £5,000, registered March 26, 1925.

Cast Iron Research Association

The Bulletin of the British Cast Iron Research Association for April contains, among other things, the following papers: "The Transverse Test and the Modulus of Rupture"; "The Rapid Determination of Structural or Constitutional Analysis of Cast Iron"; "Recent Developments in Cast Iron Foundry Practice" (containing notes on "The Relation between the Mechanical Properties and the Analysis of Cast Iron," "A Cast Iron Diagram," and "Shear Test for Cast Iron"). In the report of the council and committee activities there is an account of the official inspection of the work of the Association by the Department of Scientific and Industrial Research.

Aluminium Production in Tasmania

THE Tasmanian Government has been negotiating for some time past with a British syndicate regarding the possibilities of establishing works in Tasmania for the recovery of aluminium. Writing to the Premier from London Mr. W. D. Reid, the Tasmanian Government's official representative at the British Empire Exhibition, who has been endeavouring to interest British manufacturers and investors in the industrial possibilities of Tasmania, reported that matters in connection with the aluminium project were progressing satisfactorily, and he was hopeful that finality would be reached in the near future.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions on current problems will be welcomed*

The Consumers' Point of View

IT is a real satisfaction to be able to publish, in the first number of our Dyestuffs Monthly Supplement, so frank and stimulating an article on the dyestuffs situation from the consumers' point of view as that contributed by Mr. Sutcliffe Smith. It is safe to say that no one in the British colour industry could have written with fuller knowledge or higher authority on this aspect of the subject. Apart from his close commercial connection with important dyeing interests in the North of England, Mr. Smith has served as president both of the Society of Dyers and Colourists and of the Bradford Chamber of Commerce, and is at present chairman of the Colour Users' Association. Quite frankly, he has stood, all through the dyestuffs controversy, primarily for the interests of the consumer. In so doing he has really stood for the industry as a whole, for production can only ultimately be justified by its proper relation to consumption. In simpler words, the final test of the British dyestuff maker's success or failure is his success or failure in making what the consumer needs, and in keeping the users' interests constantly in front of the industry. Mr. Smith has been directing the dyestuff manufacturers' attention to the final standard by which their work must be judged.

A Constructive Critic

THIS important service to the textile and other colour-using industries, however, has been done in no narrow or partisan spirit. From the outset Mr. Smith has seen the need of establishing an independent dyestuffs industry for this country, and has recognised the necessary sacrifices that this, for a time, must involve. He has accepted the necessity for some temporary form of protection. He has never joined the destructive critics who have seen nothing but ill in the Dyestuffs Act and who have openly exulted in the difficulties of the British Dyestuffs Corporation. He has been loyal to all these national interests and national pledges, and it is just this loyalty that has given so much weight to the frank but scrupulously fair and always constructive criticism that he has addressed from time to time to British dyestuff manufacturers. Of this type of helpful criticism his article in this issue is an excellent example. Its whole purpose is to bring the mind of the industry back to the ultimate end for which the Dyestuffs Act was passed, the British Dyestuffs Corporation and other concerns established, and the consuming interests induced to accept temporary limitations and price penalties. Its aim is to save that end from being obscured by any subsidiary objects.

The Vital Price Problem

IT is no surprise to find Mr. Sutcliffe Smith returning again and again to the vital question of dyestuff prices. Allowing for the difficulties that British producers have had to work under, British prices, Mr. Smith still contends, remain too high, and compare unfavourably with what world competitors are paying. Indigo, for example, which is now down to 10d., was not so long since 16d. per lb.; alizarine in this country is 60 per cent. higher than it can be bought in a free market. The usual answer to this is that the cost of the dye in proportion to the total cost of the finished fabric is such a fractional item that it hardly counts; it must, however, be remembered that competition in the textile industry is so keen and price cutting so fine that a few fractional items may just turn the scale one way or the other. These matters are pointed out by Mr. Smith, not as examples of present grievances merely, but rather to emphasise the final objective. Under five years of artificial protection, it is true, much has been done; five years yet remain to run, and then, if the original aim is to be attained, the British dyestuff industry should be able to supply the needs of the Empire in all the required varieties of shade and quality and at prices on a level with those or foreign producers. Then, and not until then, will it be able to hold its own in a free market. For this purpose Mr. Smith lays down four essential conditions—intensive research, the production more and more of new products, closer co-operation between users and makers, and greater co-ordination of effort among British makers themselves.

Since Mr. Smith's article was written, Dr. E. F. Armstrong, on behalf of the Association of British Chemical Manufacturers, has given evidence on the dyestuffs industry before the committee on Industry and Trade. He also, but from another point of view, takes up this question of price, and shows that there are several other factors to be taken into account. It is only by getting the problem studied from these various points of view that it can be seen in the right proportions.

Prices and Export Trade

THE influence of the price factor is not limited to the textile industry. It affects very directly the export of British dyestuffs within the Empire and to other nations. No better, or worse, example of this could be supplied than that quoted last week in THE CHEMICAL AGE from the official volume on British trade in India for 1924–25. Here, in spite of a vigorous trade organisation in favour of British products, German houses have succeeded in regaining their dominant position in the aniline dye trade, and British imports have steadily declined. In 1921–22 we exported 1,094,000 lb.; in 1923–24 the quantity had declined to 297,000. In the same period the United States, Belgium and Holland all recorded increases, while the German aniline dye exports increased from 2,989,000 lb. to 8,531,000 lb. In the matter of alizarine dyes the position is more favourable. Within the period mentioned the export of these dyes from this country advanced from 1,863,000 lb. to 2,431,000 lb., while the German export figures declined from 2,861,000 lb. to 2,607,000 lb. No country understands better than Germany the art of underselling competitors with the object of capturing a market, even at some temporary loss, and their success may be due to clever commercial tactics in part as well as to the art of cheaper production and marketing.

Technical Advances in 1925

A FEATURE which, we are sure, will be appreciated is the review published in this issue of the technical advances in dyes and their application in 1925. This is the work of a research chemist on the staff of a firm which has taken a distinguished part in this progress. The commercial production early in the year of the first soluble anthraquinone vat colour, Soledon Jade Green, was drawn attention to at the time in THE CHEMICAL AGE. This was at once

recognised as one of the most notable achievements of Scottish Dyes, Ltd., the head of which, Mr. Morton, was the recipient of the Faraday Medal in the recent centenary celebrations. During the year further Soledon and Indigosol colours have been made available. A review of the year's work brings out very sharply the importance attached to the production of fast colours by both British and foreign manufacturers. It is satisfactory to find British makers holding their own in research and contributing a fair proportion of the advances, coming second only to the German and the Swiss firms, favoured with a long start. A selection of the more important or interesting of the year's developments is given in the article, the first place being accorded to the dyeing of acetyl silk, which is pre-eminently a British field. Apart from the production of new dyes in several classes, an economy in the mordanting and dyeing operation has been effected, and growing attention has been given to immunisation of fibres to dyes. The main outstanding developments in printing have been the adaptation of the Soledon colours and further advances in printing the Indigosols.

I. G. Developments

THE final details of the amalgamation of the leading German dyestuff factories have been worked out, and that the I.G. Farbenindustrie Aktien-Gesellschaft will begin to make itself felt in this country in the near future can be confidently anticipated. Abroad action has already commenced in that independent importing agencies of the various units of the I.G. have been fused, and it is expected that the cutting down of staff which is more or less a feature of all such centralisations will follow. It is considered that a similar development is inevitable in Great Britain, and the present is a time of considerable anxiety to a large number of British importers.

It has been stated that the capital of the new company is some £33,000,000; if this figure be correct, the I.G. would appear to be rather under than over capitalised, and its potential power is so much the greater. Among the details published in connection with the celebration of the Diamond Jubilee of one of the leading units—the Badische Company—appears the statement that the number of men employed has increased fivefold in the fourteen years 1910-1924, the number on the latter date being some 41,000.

Dyestuff Fashions in 1926

IT is not perhaps generally realised that there are fashions in dyestuffs which, it is true, are mainly reflective of fashions in textiles, but nevertheless are fashions. The outstanding example during the winter has been the prevailing shade for "my lady's" wear—bottle green—which has made a considerable difference in the output of acid green dyestuffs for wool. This had the merit in the dyestuff manufacturer's eye of being a fairly dark shade, for the production of which fairly large quantities of dyestuff were required, in contradistinction to the nondescript tints which have been the prevailing feature during the last few years. The shades for Spring are now more or less settled, and unfortunately "my lady" still prefers tints. A brochure just issued by the British Dyestuffs Corporation advertises the following:—Chartreuse, Biskra, Airforce, Foxglove, Oakapple, Dawn, Cloud, Sahara, Palm Green, and Rose Marie, but only the last two suggest any volume of business to the dyestuff manufacturer.

Another safe prediction is that there will be a considerably increased demand for colours which have good fastness to light. There has, of course, been a gradually increasing demand for a number of years, but last year's few weeks of sunshine occasioned so many complaints of lack of fastness that the rate of increase will be greatly accelerated. It is to be hoped that the movement is not overdone; most of us have been recent recipients of articles of ornament or attire which for family reasons are difficult to dispose of, and from which we are hoping to be delivered by some untoward accident. The possible destruction of the colour, either by sunlight or washing, does suggest a peaceful solution.

Dyestuffs Company's Interest in Research

ATTENTION has frequently been drawn in THE CHEMICAL AGE to the thoroughness with which American chemical firms search for new ideas in patent literature, abstracts of chemical articles, papers, etc. An example of the importance attached to this work is furnished by the handsome donation of 2,500 dollars that E. I. du Pont de Nemours and Co., the great chemical, dyestuffs and explosives organisation, has just given to the American Chemical Society towards the cost of publishing the Decennial Index of *Chemical Abstracts*. Dr. Stine, who announces this gift to Dr. C. L. Parsons on behalf of the company, has for some time held the post of chemical director. He was formerly in special charge of the dyestuffs department, and America probably has no higher authority on the efforts made by the United States—whose policy in many respects strikingly resembles our own—to establish a national dyestuffs industry. That this interest in the study of chemical literature is not limited to the executive is clear from the fact that it was the South Jersey Section of the A.C.S. (which includes a large number of du Pont employees) that first suggested to the du Pont Company a contribution towards the cost of the Index. An allocation of 35,000 dollars has also been received from the International Education Board, founded by J. D. Rockefeller, jun., and with other support the publication of the Index is now assured.

A Reminiscence

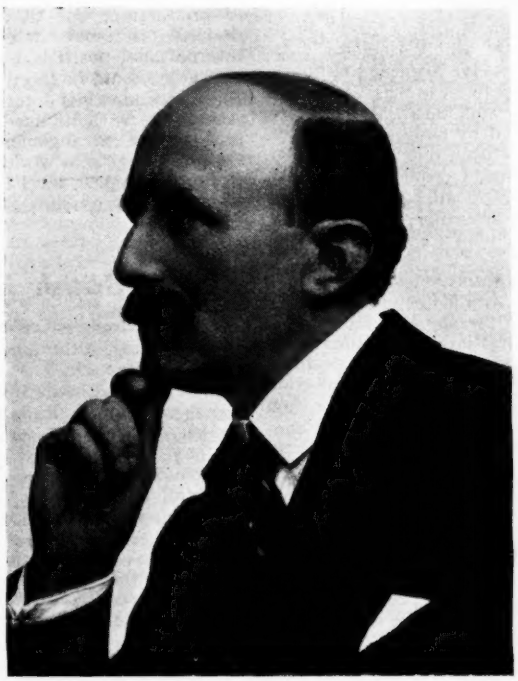
REFERENCE to this matter recalls an interesting visit which we paid some time ago to the handsome headquarters of the du Pont organisation at Wilmington, Delaware, over which we were conducted by Dr. Stine. His knowledge of the history of the American dyestuffs industry, his intimate association with the efforts made by the United States, following the outbreak of war, to establish a self-dependent industry which should supply all the colour needs of the United States, his review of the difficulties encountered in the early stage, the inevitable mistakes and their gradual rectification, his grasp both of the scientific and technical aspects of dyestuffs production and of the commercial conditions to be satisfied, are still pleasant memories. What struck one at the time, listening to his clear and rapid analysis of the situation, was the remarkable resemblance between the British and the United States policy and experiments. They, like ourselves, began with a spacious attempt to cover the whole range of colours, with the result that quality was sacrificed to quantity production, and domestic colours, hastily produced, got an indifferent reputation for fastness and other essential qualities. Then came the policy of concentration on a more limited range and increased attention to quality. And since then there has been a gradual building up of research, technical efficiency, and a closer liaison between the work of the dyehouse and the commercial needs of the consumer. The American industry has been protected by the familiar method of the tariff, ours by a system of prohibiting importation of foreign colours except under license. Without deciding which nation has done best, it is safe to say that in both cases the progress made has been more than most people would have dared to hope for ten years ago.

The Dyestuffs Situation: Aspects of the Users' Case

By H. Sutcliffe Smith

(Chairman of the Colour Users' Association; Past President of the Society of Dyers and Colourists; Past President of the Bradford Chamber of Commerce.)

I GLADLY accept the invitation which you have given to me of expressing, in some slight degree, the users' point of view in the long drawn out dyestuffs controversy. There is a danger, in this important controversy, that the issue might become obscured by *ex parte* statements, but in the main question, the establishment of a virile dyemaking industry in this country, there is not much room for two points of view. As is well known, the Dyestuffs (Import Regulation) Act was put on the Statute Book with the full concurrence of the users, and as the result of this Act they have borne many disadvantages. The users recognise that during the early years of the building up of the dyemaking industry in this country it is impossible to get down to the world's lowest competitive prices, yet it must not be forgotten that the users only agreed to the passing of the Dyestuffs (Import Regulation) Act, on the understanding that it would not place the textile and other great colour using industries in an unduly disadvantageous competitive position.



MR. H. SUTCLIFFE SMITH.

The users willingly admit that considerable progress has been made in this country in the production of dyestuffs, but they are not quite satisfied that the position is as satisfactory to-day, after five years of protection, as it should be. The gravamen of their charge is that, owing to the restrictions, the prices of dyewares in this country are too high, and compare unfavourably with what their world competitors are paying for their wares. It has been suggested in some quarters that the users lay too great a stress upon the prices of dyewares, but I think it necessary to point out that the cost of every item in the production of manufactured goods must be cut down to the lowest possible basis if we are to restore this country's great export trade to its pre-war volume. The Germans have not lost sight of this fact, as is evidenced by what Dr. Duisberg stated at a conference at Kissingen recently: "We Germans must realise that in order to live at all we must export. Export is only possible if cheap production and low selling prices are possible. Cheap production not only entails low factory costs, but what is just as important, cheap money."

I have often drawn attention to the fact that the textile industry in this country is one of the principal colour using industries, and is our leading export trade, representing 48 per cent. of the exports of wholly or partly manufactured goods, and 32 per cent. of the total exports. It is obvious, therefore, how important it is that there should be no barriers in the way of not only maintaining but increasing that important export trade, by which we pay for the bulk of the food imported into the country.

To anyone who is fully conversant with the facts, it is quite evident that the protection afforded to the British makers of dyewares is on the high side. As is well known in the trade, the British makers are now afforded protection to the extent of 150 per cent. on pre-war on the bulk of colours, and 200 per cent. on certain scheduled exceptions of vat colours. This is effected by the Dyestuffs Advisory Licensing Committee, when considering applications for licences on price grounds, adopting a factor of 2½ and 3 times respectively. That is to say, when a user makes application for a licence to import foreign dyestuffs solely on account of the foreign price being lower than the British, and the latter price is more than 2½ times pre-war level, such difference is accepted as a *prima facie* reason for the granting of a licence. I believe that the British makers recognise what a valuable concession this is, as it maintains an index figure of 250 for the bulk of their dyestuffs, as against the official Board of Trade wholesale prices index figure of 155. I think it only fair to state, however, that many dyewares are sold by the British maker at under the factor of 2½ times pre-war.

The users have great difficulty in understanding why dyeware prices compare so unfavourably with the general wholesale prices of commodities ruling in this country, and it would be instructive if they could have some enlightenment in regard to that matter. It is very disturbing to users to find, as they are regularly doing, that foreign competitors are paying less for their dyewares, and whilst they recognise that prices, during the early stages of the building up of the dye-making industry, inevitably must be on a slightly higher plane, the difference must not be such as to preclude them from maintaining and developing the sale of their goods in the world's markets.

I had occasion recently to make inquiries on the continent as to the prices which textile users are paying there for their dyewares, and I found that in most cases their prices were considerably less than what we are paying. A further serious disability of the restrictions imposed upon colour users by the Dyestuffs (Import Regulation) Act, in addition to that of high prices, is the danger of limitation in the freedom of supply of essential colours, with its consequent possibility of prohibition of access to the world's latest progress. The Act has imposed upon users the responsibility of close vigilance in regard to what their competitors are placing upon the market, whereas, with freedom of access to our markets, the latest novelties of the foreign dyemakers were previously readily brought to their notice.

In a recent speech Professor Morgan suggested that the protection afforded to the English manufacturers had not resulted in an increase in the price of dyestuffs, and he gave one concrete instance where prices had been reduced from 12s. 6d. per lb. to 3s. or 4s. per lb. I think he must have overlooked the fact that, owing to the enormously high prices which were being charged immediately post-war, there was no room for a further increase, and that the trend was bound to be downward. The users' criticism is that even the reduced prices now charged are yet much too high in comparison with what their foreign competitors are paying for their colour. In the particular instance which Professor Morgan cited, where the prices have fallen from 12s. 6d. to 3s. or 4s. per lb., I may say that the pre-war price for this colour was less than 15d. per lb., so that even at 3s. 6d. the

British makers are to-day getting an increase of 180 per cent. over pre-war.

I might also cite a very striking example, namely, the price of indigo, a dyeware of vital importance to the textile trade and of special importance in calico printing. During 1924 users were paying no less than 16d. per lb. for this colour, whereas, during the same period, their foreign competitors were purchasing indigo at probably 50 per cent. less than that. As the result of strong overtures by the users, the British makers eventually reduced their price to 10d. per lb., with a further rebate for quantity, which proved conclusively that the makers were taking an undue advantage of the protection afforded to them by the Act. There is also the case of a very important colour, alizarine, the price of which, to-day, is 60 per cent. higher than could be bought in a free market, and I know this is adversely affecting an important section of the trade. Were space available I could cite many more similar instances of a glaring character to show the difficulties that users have to contend with under the Dyestuffs (Import Regulation) Act.

Bulk Business Wanted

I should also like to draw Professor Morgan's attention to the fact that the Germans candidly admit that for non-contentious dyewares for which we receive licences to import, the prices charged to us are not nearly as low as we should pay for them were we able to place bulk business, as before the war. No useful purpose is served by making deductions from isolated cases, as has evidently been done by Professor Morgan in his recent statement, and I would respectfully suggest that these commercial questions affecting prices and costs of production are outside his activities, and can only be authoritatively handled by those who are engaged in the business from day to day.

On behalf of the Colour Users' Association, I welcome the financial reconstruction of British Dyestuffs Corporation, Ltd., as I have recommended it strongly for the last four years, feeling that the burden of over capitalisation, entailing large overhead charges, was a deterrent to the success of the business on commercial lines. This reconstruction, by the elimination of unnecessary overhead charges, should enable the Corporation to bring its prices down to a lower level, and more in conformity with what is ruling in foreign countries. The acid test of the efficiency of this great Corporation will be when it can maintain an adequate share of the export business in dyewares, and unless it can do this it is difficult to realise how it will be able to bring its cost of production into line with the great dyeware producing factories abroad. The users feel that the position so far of the Corporation has not been satisfactory. Up to now they have not felt confidence that the firm has been well or efficiently managed, or that the really close attention necessary to make the business a success has been given.

The Policy for the Future

The users would like to see more evidence of the British makers getting on to a new plane by the introduction of more and more entirely new products, originated as the result of their own research. The Germans undoubtedly visualise that their future lies in improving existing products, and introducing new ones. They recognise that, in their scientifically trained chemists and engineers, in their schools and in their experienced commercial men, they have assets which lead them to hope that they can improve their existing products, and introduce new products, and that in the future they may do better even than they have done in the past. They also realise that the future lies with their youth. This is the spirit which British users desire should permeate British dyemakers. The users cannot readily contemplate an eventual situation, whereby the sacrifices they have made during the period of the Dyestuffs (Import Regulation) Act will be nullified, and that at the end of this period the British makers are not able to hold their own in a free market.

There is one matter of real importance to the users and that is, is this country at the end of the period of the Dyestuffs (Import Regulation) Act, five years hence, to have a really virile dyemaking industry capable of supplying the needs of the British Empire, not only in variety of types but at prices equal to those paid by any of our world competitors? Unless this is achieved the sacrifices which are to-day being made by the users will have been in vain. These objects can be achieved by hard work on the part of the makers, and by closer co-operation between them and the users. There is no doubt that much of the success of the German makers was due to their close liaison with consumers, and I welcome anything in the direction of co-operation between the two branches of the industry, the production of dyes and the use of them. I should also like to see closer co-ordination between British makers. It is obvious that there is much overlapping if one may judge by the number of makers who are making and selling similar colours. It has to be recognised that the German makers are now members of one great combination, pooling their resources and their knowledge, and it is imperative that there should be a similar arrangement in this country.

According to the latest statistics, the world capacity of the production of dyestuffs is nearly twice the present consumption. Were it not for the artificial barriers which exist to-day, there would be enormous competition, which would ultimately be disastrous to all interests. For a time the users would get their dyestuffs at very cheap prices, probably below the cost of production, but that is not a consummation which is desired. Is it not time that a sane view was taken of the international position, and, led by wise statesmanship, that the facts should be faced and tackled? It should be realised that this country is determined to have a dyemaking industry compatible with its needs, and the users would welcome an international arrangement whereby British users would get the advantage of a world price, provided that that price was not on too high a level to enable manufacturers to sell their goods to the impoverished nations of the world.

British Dyestuffs Industry

Dr. Armstrong's Evidence before Government Committee

At a meeting of the Committee on Industry and Trade, held on Wednesday, Dr. E. F. Armstrong, representing the Association of British Chemical Manufacturers, gave evidence regarding the British dyestuffs industry. Dr. Armstrong dealt with criticisms of the industry as to the price, range, and quality of its products. He pointed out that criticisms based on a comparison with price in other countries must take into account the difference between the internal and external purchasing power of depreciated currencies. He claimed that on this basis the French user is paying more than 2½ times pre-war prices, which is, generally speaking, the maximum the English user is asked to pay. Dr. Armstrong stated that the same was true of Italy. He gave figures to show that in September, 1925, the average weighted price of the British Dyestuffs Corporation's dyes was 2·35 times the corresponding pre-war price, a ratio which corresponds to the increases in raw materials and labour, while the ratio for wages and salaries is nearer 3. He contended that the statement often made that the high price of dyes is responsible for the diversion abroad of trade in finished goods is shown from official figures to be untrue. He said that the proportion of finished goods in total exports of cotton goods is rising.

Home Production of Finer Dyes

Dr. Armstrong stated that the criticism that this country is dependent on Germany for the finer dyes is incorrect. No vat dyes were made here in 1914, but to-day one firm alone offers 23 compounds in this series, and the number is larger for the industry as a whole. Imports of these colours for six months to June, 1925, were only some 93,000 lb., while home production was of the order of more than half a million pounds, excluding indigo. The total home production of all colours, during this period was over 13 times the amount imported, showing the substantial independence of this country. As regards the argument that dye users in this country are prejudiced in comparison with their foreign competitors owing to the operation of the Dyestuffs (Import Regulation) Act, Dr. Armstrong said that users have access to all known sources of supply through the Licensing Committee, on which users have a predominating voice, and he pointed out that regulations for the importation of dyes exist in France and America.

Dyes and their Application: Technical Advances in 1925

By a Dyestuffs Research Chemist

The following review of the past year's developments, by a member of the staff of a leading dyestuffs manufacturing company, shows the importance attached to the production of fast colours and the progress in research maintained by British firms.

THE technical advances in dyes and their application during 1925 have been principally along the lines promised by earlier developments of the last few years. An important announcement at the beginning of the year was the marketing of the first soluble anthraquinone vat colour Soledon Jade Green. During the year further Soledon and Indigosol colours have been put out. Although the fullest exploitations of these series cannot be expected until more complete ranges are available, there can be no doubt of the ultimate importance of these soluble vat colours. Examination of the year's work brings out very sharply the importance which is being attached to the production of fast colours by both British and foreign manufacturers. By far the largest proportion of recent work is confined to the faster series and even in the others attention is in the majority of cases being focussed on making the most of the fastness that is available. Even the azo colours, which on account of their large numbers and general application naturally offer great opportunities for expansion, reflect the same tendency, and the influence of the azo dyes containing components of the Naphthol AS type can be seen in a large number of the recently described colours. Next in numerical order to the azo colours come the various vat series, indigo, anthraquinone, wool vat dyes and the newly developing perylene dyestuffs. These are followed by smaller members of patents, etc., dealing with the other series. British dyestuff makers appear to hold their own in research and to be contributing a fair proportion of the advances, coming second only to the German and Swiss makers. A selection of the more important or interesting of the developments will be given below, dealing first with acetyl silk which is pre-eminently a British field.

Cellulose Acetate

In the dyeing of acetyl silk there are no broad new general developments to report comparable in importance to the Ionamines, Duranols, Celatenes and S.R.A. series. This does not indicate any falling off in the attention which is being given to the question, a study of the patents published during the year showing that the work has been principally in amplification and consolidation of preceding developments. In methods of increasing the affinity by assistants there may be mentioned the use of the salts of oxy acids of nitrogen or chlorine (E.P. 216,838. Bayer) by means of which the affinity for basic dyestuff is increased so that deep shades may be obtained. In another patent of the same company (E.P. 215,783) dyeing is carried out in the presence of piperidine or guanidine, etc., this being an extension of a previous patent (215,373) in which the unhydrogenated derivatives—*e.g.*, pyridine—were employed. J. R. Geigy, S.A., patent the printing of dyestuffs having little affinity along with aromatic carboxylic or sulphonic acids. The discovery that products may be improved for dyeing acetyl silk by introducing carboxylic acid groups was made by the B.D.C. The carboxylic acid group not only makes the resulting compounds more soluble in water but its organic structure makes them at the same time more soluble in an organic substance like cellulose acetate, and in this respect distinguishes them from compounds containing the sulphonic acid group. The original conception has been amplified, as for example in E.P. 224,363, 225,678 and 227,923 (B.D.C., J. Baddiley and W. Tatum) where an aminoanthraquinone is condensed with a carboxylic acid of an alkylene oxide, such as glycidic acid, or with a sulphochloride of salicylic acid or other orthohydroxy carboxylic acids. These products are primarily intended for wool on which they give very bright shades. Products dyeing in blue to green shades on acetyl silk are also obtained from carboxylic acids (such as anthranilic) by condensing with 1.5-dichlor anthraquinone substituted in the 4.8-positions by amine hydroxy or similar groups. A patent on similar lines is E.P. 232,599 (M.L.B.), where the carboxylic acid group is introduced as a glycine, obtained, for example, in the normal manner by condensing an amine with chloracetic acid. One of the desiderata of the colours for cellulose acetate has been a fast pure shade of yellow. Celatene Yellow has been one of the most widely used yellows for this purpose, but this has been recently improved upon in Celatene Fast Light Yellow where the fastness to light is claimed to be irreproachable. Products dyeing in fast shades in the yellow end of the spectrum are described in E.P. 238,936 (S.D.L., J. Thomas and E. G. Beckett), hydroxy and chlorhydroxy anthraquinones, E.P. 234,533 (S.D.L., J. Thomas and L. J. Hooley), condensation products of phthalic anhydride and orthochlorphenol, E.P. 236,037 (B.D.C., J. Baddiley and J. Hill), fast greenish yellow dyes from 1.3-dihydroxy quinoline coupled with diazotised aniline, toluidine, etc.

Further Ionamine Products

A large number of further products of the Ionamine class are described in E.P. 237,139 (B.D.C., W. H. Perkin and S. C. Bate). Although it was found in the earlier efforts of dyeing acetyl silk that the presence of sulphonic acid groups greatly reduced affinity and while the rule still holds in the majority of cases, two or three notable exceptions have been found recently. In these cases the position of the group is of great importance, the effect of the group being counteracted by adjacent ones with an opposing tendency. It seems probable, however, that even in these cases the disadvantages must to some extent remain if only as a decreased fastness to washing and, except in cases where the dyestuff would be useless, without the group, this disadvantage will have to be reckoned against the improved solubility. E.P. 228,557 (M.L.B.) claims the use of 1.4-diamino or aminohydroxy anthraquinone or their alkyl derivatives, etc., which are sulphonated in the 2 or the 3 position. According to E.P. 226,948 (B.D.C. and G. H. Frank) monosulphonated dyestuffs containing no hydroxyl group, but having the sulpho group in the ortho position to the azo group or azo dyes containing the sulpho group in the peri position to an amine group in a naphthalene nucleus have affinity for cellulose acetate.

A blue dyestuff is described in E.P. 231,206 (S.D.L., J. Thomas, E. G. Beckett and R. Tonkin) which is stated to be a hexamino dianthroquinoyl thio ether. A paper in the *Journal of the Society of Dyers and Colourists* (1925, 41, 97-8) describes the synthesis of an insoluble azo dye, tartrazine on the fibre.

The British Celanese Co.'s own contributions to the dyeing and printing of Celanese include E.P. 237,943 and 239,634 (B.C.L. and G. H. Ellis) dealing with unsulphonated nitro diaryl amines and derivatives, which may be employed either in aqueous or colloidal solution or by this company's solubilisation processes, and E.P. 239,634 which extends the solubilisation method to vat dyestuffs of the anthraquinone series which can thus be used without vatting.

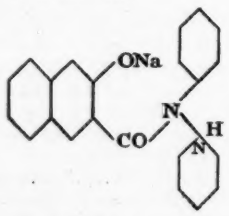
Recently the B.D.C. have announced a process for obtaining discharges. The dyestuffs used for acetyl silk are not generally those with which great difficulty would be experienced in discharging were it not for the limitations imposed by the fibre itself. Hydrolysis especially must be avoided or the colour may be fixed more firmly. A recent patent of the B.D.C. E.P. 240,293 (L. G. Lawrie and H. Blackshaw) shows that acetyl silk may be mordanted with metals if these are applied in the form of thiocyanates, benzoates or salicylates. The similarity of this method of mordanting to the previous one of dyeing with carboxylic acids is apparent.

Azo Dyes

As already stated, a considerable number of fast azo dyes are being produced, particularly those in which use is made of constituents such as the arylides of β-oxy naphthoic and similar acids, and those including pyrazolone derivatives. The Chemische Fabrik Greisheim continue their developments in E.P. 399,060, describing a deep violet dye from 3-nitro-1.4-dianisidine, and the α-naphthalide of 2.3-hydroxy naphthoic acid; E.P. 235,169, insoluble azo dyes fast to vulcanising, and which may be produced on the fibre, from the β-naphthalide of 2.3-hydroxy naphthoic acid and unsulphonated

diazo compounds; and in U.S.P. 1,529,739, which describes the coupling of tetrazotised derivatives with β-hydroxy naphthoic acid.

British Synthetics, Ltd., and E. B. Higgins, E.P. 230,920 describes components of the type—



in which the replacement of the free hydrogen atom of the NH in the arylido group by a quaternary ammonium base gives better fastness properties.

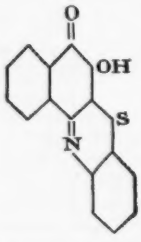
Fast shades resembling alizarine pink are obtained by coupling substituted derivatives of alkyl oxy-3-amino benzoic acid with β-hydroxy naphthoic acid, U.S.P. 1,522,089 (M.L.B.). E.P. 225,097 (L.B.H., A. Clayton and J. A. Stokes), yellow pyrazolone dyes are obtained from diazotised 2.6.8-naphthylamine disulphonic acid and sodium dioxy tartrate. A large number of pyrazolone derivatives are described by other manufacturers. E.P. 235,334 (B.D.C. and H. H. Hodgson) gives wool azo dyes by coupling amino thio phenol ethers with azo components containing sulphonic acid groups. Space does not permit mention of the large remaining number of products.

Several papers on triphenyl methane dyes have been published, mainly of a theoretical nature, dealing with constitution, aurin, diphenyl naphthylmethane derivatives, etc.

Wool Vat Dyes

Apart from the anthraquinone and indigoid vat dyestuffs, a few derivatives of the arylidoquinone and related chemical types were put on the market before the war by Meister, Lucius, and Brüning, principally, Helindone Yellow CG vat and Brown CM vat which, used in conjunction with one or two of the indigoid series, gave a fair range of shades. The quinone properties of these are stronger than with anthraquinone, and they reduce more readily and require little alkali; they can be worked up by evaporating to dryness in the presence of hydrosulphite and molasses, lignin sulphonic acids, etc., to give stable easily soluble leuco forms which are practically speaking soluble in water, requiring only the addition of a little ammonia and hydrosulphite to the dyeing vat. They do not come into the same class for wool dyeing as the Soledons and Indigosols, which have already been dealt with, for fastness and brightness, but they form a valuable series much faster than the bulk of the wool colours excluding the chrome and acid alizarines. Some of these products may also be used as mordant colours. A considerable number of patents have been taken out during the last few years, dealing with these and similar dyestuffs, including the thiozines, G.P. 402,642, A.G.F.A. Nitrophenyl sulpho chloride is condensed with α-hydroxy naphthalene, and the resulting diaryl sulphide treated with alkaline hydrosulphite.

E.P. 236,795 (A.G.F.A.) describes, along with similar substances, a thiazine having the probable constitution shown below.



These are used as mordant colours.

Several patents have been taken out by L. Cassella and Co.

Indigoid Vat Dyes

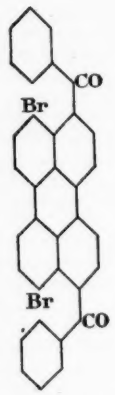
The discovery of indanthrene was the result of an attempt to prepare an anthracene analogue of indigo, and derivatives of this type have since been prepared. In E.P. 210,413, S.C.I.B., anthraquinone-2-carboxylic acid, 3-thioglycol will condense with the usual constituents or can be oxidised in air to the double compound. These compounds may also be reduced to the corresponding anthracene ones with zinc and ammonia. A red indigo dyestuff of a new type containing the pyridine nucleus and prepared from pyridyl glycine has been synthesised by Reidel (G.P. 414,146).

Three papers on the constitution of this compound are found in Berichte, 1924, 901, and 1925, 4 and 393-7. The cultivation of bacteria especially suitable for the indigo fermentation vat is given in E.P. 205,834, M.L.B. The other indigo dyes are too numerous to mention in detail.

Dibenzanthrone Dyes

This group is really a special section of the perylene series, and both belong to the anthraquinone vat dyes, but it is convenient to consider them separately.

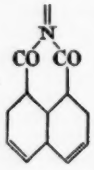
Of theoretical interest is the synthesis of isoviolanthrone by Zinke and his collaborators (Ber. 1925, 323-332), by halogenating perylene, separating the 3.9-derivative and condensing this with benzoyl chloride and aluminium chloride. The adjoining formula represents the first stage in the aluminium chloride synthesis, the final one being double ring closing with loss of two molecules of hydrobromic acid.



Several patents deal with syntheses of derivatives of the Caledon jade green series, hydroxy and methoxy derivatives of benzanthrone and dibenzanthrone are described. (G.P. 414,203, E.P. 218,255, M.L.B. E.P. 234,173, M.L.B.) These syntheses, which cannot be described in detail, are extremely interesting. G.P. 410,011 describes a thiomethoxy derivative of dibenzanthrone.

Perylene

This hydrocarbon was synthesised for the first time by Scholl, 1910, although compounds such as helianthrone, dibenzanthrone, etc., containing this nucleus had been known previously. The extremely valuable properties of some of these latter as vat dyestuffs, including the more recently discovered Caledon jade green, has directed considerable attention to this substance. Unlike all the other hydrocarbons used in dyestuff manufacture, this does not occur in coal tar, so that it starts with a considerable economic handicap. Synthesis usually starts from naphthalene derivatives, but many of these give only poor yields. The method is usually one of heating with condensing agents such as aluminium chloride, zinc chloride, and caustic potash. By the latter method derivatives of naphthalene 1.8-dicarboxylic acid, as for example, the imide, give the best results, two molecules joining through the free peri positions. This method of synthesis was due to Kardos. The number of patents taken out during the year is large, and of great interest. Perylene quinone itself may be regarded like anthraquinone as a starting point for the synthesis of dyestuffs; it is, however, a more powerful chromogen, and its simplest derivatives have vat dyeing properties as distinct from anthraquinone. Of the many products described, time will show which are likely to be of technical importance.

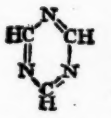


Anthraquinone Vat Dyes

Excluding the compounds already mentioned under the two preceding headings, the following may be mentioned:—L. Cassella, G.P. 413,464, patent a new method of chlorinating indanthrene in the presence of sulphur compounds and obtain a dichlor product with the same fastness to bleach as previous brands containing even three and four atoms, and giving shades of blue on the greenish side instead of the previous red shades of the fastest brands. A new indanthrene which is probably the 3.3¹ dicarboxylic acid is made by the caustic fusion of anthraquinone-2-amino-3-carboxylic acid instead of the simple 2 amino compound. A new vat red is described by Scottish Dyes, J. Thomas and E. G. Beckett (E.P. 230,116) by nitrating, reducing and benzoylating anthraquinone-1-phthalimido. Several methods of obtaining black vat dyestuffs from nitro dibenzanthrone which will not need a treatment with chemic, etc., to develop the black colour have been worked out. Some new Caledon printing blacks have been put on the market during the year.

The Society of Chemical Industry, Basle, has extended the

anthraquinone dyestuffs by the introduction of the triazine derivatives. Starting with a trihalogen derivative such as cyanuric chloride and interacting with amino anthraquinones, one, two, or three molecules may be introduced. Nor need these all be the same or even all amino anthraquinones, and as also the amines may be themselves substituted, a very wide range of products becomes possible.



G.P. 399,485. Anthraquinone triazine derivatives containing free amino groups in the anthraquinone molecule are heated with acylating agents such as benzoyl chloride, yielding reddish yellow shades.

U.S.P. 1,523,308. 1.5-diamino anthraquinone is condensed twice with cyanuric chloride and the product further condensed with α-amino anthraquinones. E.P. 220,302, naphthol derivatives are condensed with cyanuric chloride. E.P. 237,872 amino anthraquinone acridones and thioxanthrones are condensed with cyanuric halides.

Dyeing

An economy in the mordanting and dyeing operation is effected in E.P. 236,388 and 237,054, C. S. Bedford, the dichromate being used up in the mordanting process, and the dyestuff then added to the same liquor at the close of the dyeing operation. The absorption and fixing of aluminium mordants is examined by Orlow and Shebenew (*Chem. Zentr.* 1925, 1248) and the same problem has also been dealt with by J. K. Wood amd A. Wooller (*J. Soc. Dyers and Cols.*, 1925, p. 47). The dyeing of hair, fur, skins and animal fibres is dealt with in several patents. The dyeing of indigosol is protected by E.P. 212,546 involving the use of sodium nitrite as a developer; E.P. 218,649 (D. and H.) the dyeing of animal fibres with acids or acid salts in the bath, in an analogous manner to acid dyestuffs, followed by the usual development.

E.P. 220,964 (D. and H.) combined shades with indigosol and azo dyestuffs and nitrosamines, etc.

E.P. 228,510, 228,514 and 230,022 (C.F.G.E.): Dyeing with the addition of Glauber's salts, etc., and E.P. 231,189 (D. and H.) Reserve effects. E.P. 234,829 (D. and H.) Immunisation, or the rendering of fibres resistant to dyestuffs, has attracted growing attention during the past year.

Printing

No outstanding developments need recording, apart from the application of the Soledon colours for printing and further advances in the methods of printing the indigosols. E.P. 212,546, 218,649 and 220,964 (D. and H.) (the oxidising agent is incorporated with the printing paste with or without a catalyst and then steamed). E.P. 234,829 (D. and H.) (reserve effects). The preparation and composition of the printing paste is of the greatest importance to the printer and is probably to be regarded almost more as an art than a science. Printing can be carried out cold by using ethylene glycol or thiodiglycol along with readily soluble dyestuffs. (Geigy G.P. 400,684) and steaming the print. In an alternative method the steaming may be dispensed with. The stability of pastes for hand block printing is increased by the use of zinc hydrosulphite. G.P. 411,213 (Cassella). The scratching of the printing rollers and doctor during printing, especially with alkaline paste, is an obscure and not infrequent occurrence. Several articles on this have appeared lately, especially in the German literature. It seems probable that this is not always caused by the same factor. E.P. 226,164 recommends the use of highly viscous constituents in the printing pastes. Several advantages are claimed for adding resorcinol to the printing pastes, deeper and better shades being obtained, probably due to its solvent action, especially with basic dyestuffs. Glycerol derivatives, such as the ethers or acetates, are used in the pastes in G.P. 321,007 (M.L.B.). Colour discharges on vat grounds with azo dyes of the β-naphthoic acid arylide type are produced in G.P. 410,302 (B.A.S.F.). Colour resists with vat dyes under aniline black are obtained according to Rebert and Lautz and to G.P. 418,414, Haller and Kurzweil.

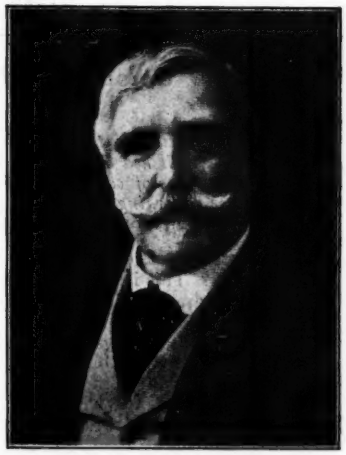
German Dyestuff Prospectus

THE new German dyestuff industry trust has issued a prospectus to the extent of 465,600,000 marks of new ordinary shares at 110. Prospects of dividends are said to be favourable.

The Dyestuffs "Who's Who"

(1.)—Colonel Sir Edward Brotherton, Bart.

SIR Edward Brotherton is a Lancashire man. He was born in Ardwick in 1856 and was educated at Owens College. After leaving there he entered the service of a Lancashire chemical concern, but, desiring to enter business on his own account, he founded at the age of 22 the firm which later became Brotherton and Co., Ltd. His first factory—which is still in operation—was established at Wakefield in 1878. After four years a still larger factory was established at Leeds, and then came in fairly rapid succession additional works at Stourton, Birmingham, Liverpool, Glasgow, Sunderland, Workington, and Middlesbrough. These were primarily engaged in the manufacture of ammonia, tar products, and sulphuric acid.



SIR EDWARD BROTHERTON.

At the outbreak of war Sir Edward Brotherton threw himself wholeheartedly into the preparation of munitions of war. The manufacture of concentrated ammonia liquor was practically doubled by the erection of distillation plant on the premises of several of the largest gas works; and there were also erected, and successfully operated, an oleum factory at Birmingham, a T.N.T. factory at Liverpool, and picric acid factories at Leeds and Wakefield. Immense quantities of explosives were produced at these points, the capital employed being furnished entirely by Brotherton and Co., Ltd.

In 1917 Sir Edward purchased from the Board of Trade for £135,000 the Mersey Chemical Works, Bromborough, Cheshire, which had been founded by a combine of the Badische, Bayer and Berlin Aniline companies for the manufacture of dyestuffs and hydrosulphites. It was a characteristically bold venture, and it has achieved the success it merited. When purchased the factory was producing a range of twelve colours, but it now produces eighty-two, and the output of hydrosulphites has increased in much the same ratio. The factory specialises in the manufacture of the metachrome colours, of which it has an excellent range; but it also offers a very full range of acid colours and has recently commenced with the successful manufacture of basic colours. In shade and fastness all colours manufactured at Bromborough compare favourably with pre-war German colours of the same class, and therefore it is not surprising that there is a steady demand for tha output.

In common with other independent makers of dyestuffs, Sir Edward views with great concern the recent action of the Government in parting with its shares in the British Dyestuffs Corporation for about one-third of the purchase price. He considers that this action places the British Dyestuffs Corporation in a favoured financial position—there being an absence of any Government funds for writing down the capital of the independent makers, who are still paying interest on their full overdraft at the banks—and he submits that what has been done by the Board of Trade is detrimental to the interests of the independent makers, and therefore prejudicial to the best interests of the nation. In his opinion the country cannot afford to allow the independent makers to be crushed out of existence.

Sir Edward has found time during his very busy life to interest himself in public affairs, and has rendered valuable service to the community. He was Mayor of Wakefield in 1902-1903 and Lord Mayor of Leeds in 1913-1914. He represented Wakefield in the House of Commons in the period 1902-1910 and again from 1918-1922.

His philanthropy is well known. In 1903 he founded the

Brotherton Charity Fund at Wakefield for the provision of pensions for necessitous men and women of Wakefield; and to induce thrift, every child in the Wakefield elementary schools has been presented with a bank book containing a deposit of one shilling. At the outbreak of war, when he was Lord Mayor of Leeds, he raised and equipped, at his own expense, the Leeds "Pals" Battalion. He also subscribed £5,000 to the Prince of Wales' Fund, and took up half a million pounds in war loan, the interest upon which was returned to the Government. In 1920 he gave £20,000 to the Leeds University to found a Chair of Bacteriology. For his public service and beneficence he was created a baronet in 1918, and in 1923 he received the LL.D. degree, *honoris causa*, from the University of Leeds.

Causes of Colour and Dyeing Properties

By A. Davidson

By way of introduction to his book, "Intermediates for Dyestuffs," just published by Ernest Benn, Ltd., Mr. Davidson discusses the causes of colour and dyeing properties which, as he says, form the "working hypothesis of the dyestuff chemist." The following extract is reproduced by permission of the publishers.

WHAT are the causes of the colour and the dyeing properties of a dyestuff? This is a twofold question. Colour and dyeing power are separate and distinct qualities. A dyestuff may be so fixed on or in the fibres of the material to be dyed that it cannot be immediately washed off. Not all coloured substances possess this property. On the other hand, there are colourless substances, such as tannic acid, *b*-hydroxynaphthoic anilide, hydrated alumina, etc., which can be fixed, in the sense just mentioned, on cotton, wool, and other textile materials.

As regards the cause of the colour in a dyestuff, the preliminary generalisation can be made—though it does not carry us very far—that the known dyestuffs are complex organic compounds containing:—

(*a*) The ringed nuclei of benzene, naphthalene, anthracene, and certain related ring structures, such as those of carbazole, acenaphthene, indole, etc.

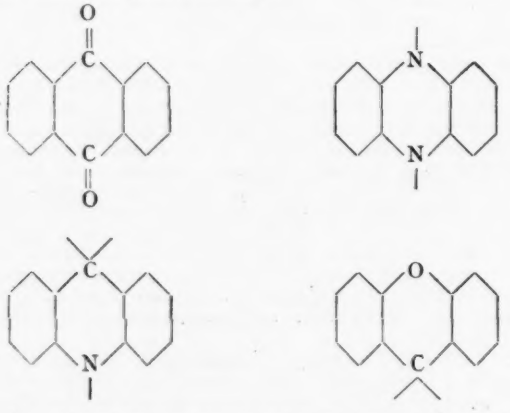
(*b*) Connecting atoms, or chains of atoms, of carbon, oxygen, nitrogen and sulphur.

(*c*) Substituent groups attached to the rings, of which the most prominent are the amino, hydroxyl, sulphonic acid and nitro groups.

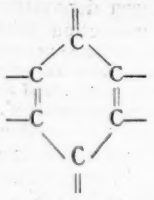
Compounds are, however, known which fulfil all these conditions and yet are colourless. A theory proposed by O. N. Witt proceeds a stage further, and attributes colour, or a predisposition to colour, to the presence of certain "chromophoric" groups—*e.g.*,

$$>C=O\ ,\quad >C=N-\ ,\quad -N=N-\ ,\quad -NO_2\ ,$$

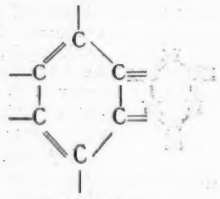
or the more complete groupings:



Another view is that proposed by H. E. Armstrong and A. G. Green, according to which quinonoid arrangements (see formulæ following) in the carbon rings are responsible for the colour. The two views are not mutually exclusive, but are, indeed, to some extent complementary.



p–Quinonoid



o–Quinonoid

Dyeing properties—the possession of affinity for the textile fibres—are to be attributed, according to the second part of Witt's theory, to the presence in the molecule (together with the chromophores) of the hydroxyl and amino (or substituted amine) groups. These groups not only impart affinity for the fibre, but also intensify the colour of the substances, and are hence called "auxochromes."

These generalisations are sufficiently in accord with experience to serve as useful guides in the mazes of dyestuff chemistry, and are, in fact, the working hypothesis of the dyestuff chemist. They indicate that the making of dyestuffs involves the following conditions:

(*a*) *The fundamental substances*—the raw materials—are the so-called "aromatic" compounds, benzene, naphthalene, anthracene, and the related toluene, xylenes, phenol, creosols, carbazole, acenaphthene, and so on. The sole economic source of these substances at present is coal tar, which therefore forms the starting point for the manufacture of dyestuffs.

(*b*) *The intermediates*. The raw materials must be so acted on, by various reagents, as to introduce into them the required chromophoric and auxochromic groups, or groups which may in the final stages be convertible into chromophoric and auxochromic groups. Thus, for instance, benzene is nitrated to form nitrobenzene, and this reduced to aniline; naphthalene is sulphonated, and the sulphonic acid converted into a naphthol; anthracene is oxidised to anthraquinone, and so on. None of these products is a dyestuff, but all are capable of immediate conversion to dyestuffs by further operations. They form the intermediates for the dyestuffs.

(*c*) *The dyestuffs* are formed in general by the condensation together of two or more intermediates.

In the preparation of both the intermediates and the dyestuffs, certain non-aromatic substances (apart from the inorganic reagents—the acids, alkalies, etc.) are employed. Thus, formaldehyde and phosgene are used for condensations with amines; methyl and ethyl alcohols, chlorides and sulphates for the alkylation of amino and hydroxyl groups; acetic acid and anhydride for the acetylation of amino groups; acetoacetic ester and oxalacetic ester for condensation with hydrazines to form pyrazolones, and so on. These non-aromatic substances are therefore also, in a sense, intermediates for dyestuffs, but they are, perhaps, more properly to be considered as auxiliaries than as intermediates.

No definite and general line of demarcation exists between the intermediates and the dyestuffs. A substance may at the same time be a dyestuff and an intermediate for other dyestuffs. A separate study of the intermediates is necessitated rather by convenience due to the wide scope of the subject than by any strictly logical difference between them and the dyestuffs.

Dyestuffs Publications

A FULL range of pattern cards and leaflets on the subject of dyeing of Celanese in many styles with their special S.R.A. colours alone or for mixed goods in conjunction with other dyestuffs has been issued in an excellently produced brochure by British Celanese, Ltd. A large pattern card illustrates the range of these colours on pure Celanese, also dyeings of these colours with cotton colours from the same bath on mixed goods of cotton and Celanese.

Leaflets on the following subjects are also included:—"General Notes on Practical Dyeing," "Garment Dyeing," and "Fast-to-light Dyeings," together with Fastness Tables.

The Colour Users' Association has just issued its *Vade Mecum* for 1926–27 containing a list of members and many valuable tables and notes.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Yorkshire

Bradford, January 7, 1926.

THE more normal condition of trade in October as compared with the depression experienced as a result of the wages dispute in the textile trade during the two previous months has been maintained through November and December. Allowances have to be made, of course, for the Christmas holidays and a tendency on the part of buyers to post-date orders to January. Many woollen mills in Huddersfield, particularly in the Colne Valley, are working full time and overtime. "Between Season" operation of pattern dyeing occupies the attention of dyers of low unions with consequent diminution in dyestuffs consumption. The Bradford warp and slubbing dyers are slack, while dyers of cotton pieces and dress goods are fairly busy. The carpet trade is now affected by the general trade depression. Conjecture with regard to the outlook for 1926 is busy. The optimism so marked last year at this time is absent, but there is a quiet confidence that business during the coming year will be on a more stable basis.

Perhaps the most noticeable feature under the subject of price conditions is the temporary hardening of benzol; inquiry is active for toluol, solvent naphthas (90/160 at 1s. 5½d.) and creosote; there is moderate business in aniline oil at 7d. per lb., in loaned drums carriage paid; dinitrochlorbenzene at £84 10s. per ton, delivered. The demand for dinitrotoluenes of low setting points has caused prices to harden appreciably, 8d. per lb. being paid to-day as against 4d. and 5d. of less than a year ago. The increase is accompanied by a fall in the prices of the high grades, 9½d. being quoted for bulk for S.P. 66/69° C. Business is sustained in nitrobenzene at 4½d. to 5d. per lb. Orthonitrotoluene maintains its scarcity and consequent enhanced price of about 6½d. per lb.

Sulphur blacks, having regard to the fact that they now secure very little more than pre-war prices, cannot be counted as one of the most remunerative of lines for the dyestuffs maker. Moreover, output has suffered considerable set-back from cessation of demand from China for black dyed pieces. The prices of these products and of some other colours such as acid reds and scarlets manufactured in England should give the consumer pause when framing resolutions for the repeal or suspension of the Dyestuffs Act.

Major and Co., Ltd., of Hull, have paid a dividend of 6 per cent. on the 6 per cent. cumulative preference shares for the year ended March 31, 1925, of 8½ per cent. on the 8½ per cent. cumulative preference shares, and have carried forward the sum of £12,459. The directors of the United Indigo and Chemical Co., Ltd., have decided to pay interim dividends at the rate of 5 per cent. per annum on participating cumulative preference shares, and of 5 per cent. per annum for six months ending December 31, 1925, on ordinary shares.

Lancashire

Manchester, January 7, 1926.

The time of writing is that period of universal stock-taking, Christmas to New Year; business is dull and sales are for forward delivery. The customary reviews representing the nation's stock-taking in every phase of activity crowd the newspapers, and optimists give vent to their forecast of a prosperous 1926 with so much enthusiasm that the temptation to doubt the soundness of their reasoning immediately arises. On the whole it would appear that those connected with the dyestuff industry were with the majority in their lack of friendly feeling for 1925.

Indigo means enough to the man in the street to warrant the drop in its price from 1s. 4d. to 10d. appearing as "news" in the daily press, but it is only characteristic of the trend in prices of dyestuffs in general during the year, and yet not a single British dyestuff manufacturer has gone out of business during the period. There is no evidence that the difference in prices represents a profit enjoyed in January, 1925, which has since disappeared, and it is much more probable that it is accounted for by cheaper raw materials and many economies and improvements which necessity has devised.

The end of the fall in prices is not yet, but, on the basis of 1925, there is no reason to doubt the ability of the dyestuff manufacturer to survive. Hard thinking, plain living and work are not new to the northern industrialist; he has thrived on them before, and there is ample evidence in the past year that he has decided to return to the first principles on which his former prosperity was based. It is to be hoped, then, that 1925 represents a return to sanity, and that a continuation of the same policy in industry in general—and in the dyestuff industry in particular—will see a reward worthy of the sacrifice of some of the recently acquired art of living which, although undoubtedly desirable, does not appear to have had a beneficial effect upon industry.

In the meantime, the paramount need of the dyestuff manufacturer is greater bulk of business. With the present small demand his overhead charges are far too high, numbering as he does a greater proportion of salaried men among his employees than if he were engaged in any other business. The only hope for such increased demand is a recovery in the textile industries, and there seems to be little prospect of the latter occurring until the disturbed state of such huge markets as China, Russia and the Near East is a thing of the past. It is a time which calls for courage, and the recent flotation of a number of new artificial silk companies does, at least, suggest that the spirit of enterprise is not dead in us.

Midlands

Leicester, January 7, 1926.

The volume of trade in dyestuffs in this area is still small, this to some extent being due to the continued demand for pale shades in hose and knitted fabrics. The trade has had a considerable turnover from artificial silk to woollen hose. Some manufacturers of artificial silk and cotton hose are offering their stocks of these goods at much reduced prices. Dyers having suitable plant for woollen hose and fabric have been able to run at full time during December after a long period of depression. This better state of affairs was not expected by many manufacturers to last very far into the New Year, although a further spell of cold weather would doubtless bring further orders, and a much better feeling exists in this section of the trade. The change from artificial silk to wool has had the effect of slightly increasing inquiries for level dyeing acid wool colours with a corresponding falling off in sales of direct cotton colours.

Since the Silk Tax was imposed most dyestuff manufacturers have had inquiries for dyes suitable for the dyeing of real silk and cotton hose. The leading dye firms can supply these and give efficient technical service in this direction, and as soon as hosiery manufacturers have mastered certain minor difficulties, development, which appears to have been rather slow up to the present, will probably be more rapid. The most satisfactory method of dealing with these goods from the dyers' point of view seems to be to dye the cotton with direct dyeing cotton colours, which leave silk more or less unstained, and filling up the silk portion with neutral dyeing acid colours, such as sulphocyanines, Milling scarlets and Indian yellow or citronine.

The Nottingham lace dyers are now using for curtains vat dyestuffs of excellent fastness to light and washing. Colours of the anthracyanine series find most favour, direct cotton colours, which until the last few years were used almost exclusively for lace curtains, having been superseded by the faster vat colours.

The prices for most dyestuffs are easier and contracts have been taken at rather lower prices over 1926. The prices for many colours have now reached figures that are not remunerative to the dye manufacturer—further drastic reductions, therefore, are not likely to occur. There may be a gradual decline in prices for some dyestuffs as manufacturing costs can be lowered, but the fall will be far less vertical than has been experienced during the last two years.

Luton, January 7, 1926.

With Christmas over and the New Year commenced, Luton bleachers and dyers are in the midst of the busy season, and are

now dyeing the spring shades. Dyers are certainly very busy on small lots, but each year the bulk orders seem to decrease. Colours for the coming season are distinctly of the light and bright variety; scarcely anything above a medium is being dyed, ranging right down to the most delicate pastel shades. Lettuce, the new green shade, is very popular and amongst others may be mentioned amber, bois de rose, La Valliere—a delightful shade of mauve—crystal grey, watermelon and meerschaum. Prices have varied but very little during the last year, but there has been a little "cutting" on the finer braids. Unemployment is said to be non-existent in the straw and felt trade at the present time and many bleachers and dyers have lately been advertising for men—a most unusual occurrence.

It is now nearly twelve months ago since it was announced in Luton that one of its foremost bleaching, dyeing and felt hat body manufacturing firms was about to open up an American branch at Peekskill, in conjunction with a well-known importer. The project apparently fell through, but the Luton manufacturer referred to has recently been in the States again, and also in Canada, and it is now reported that there is every prospect of the original arrangement being carried out even if in a modified form.

Scotland

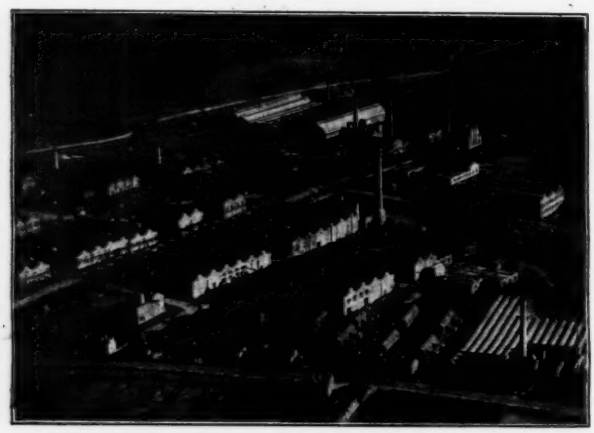
January 7, 1926.

The end of the year shows a growing feeling in many quarters that the Scottish textile trade is in for a slightly better time and that a corresponding improvement in dye sales is promised. The feeling, however, is by no means universal, but it is almost certainly more than a sectional one. Inquiries bring out no marked features in any of the various series, nor can such be really expected at the present time. The department where conditions appear to be most favourable is that of the fast colours, particularly the vat colours for dyeing and calico printing. There is little doubt that the use of these products is continually on the increase and there seems a distinct tendency on the part of users who have not dealt with them before to give them a trial.

Manufacturers report satisfactory trade during December and a distinct improvement over other parts of the year. An improvement in one section of the dye market, however, is likely to be counteracted in another one, and this may be the case to some extent with fast dyes. Prices on the whole remain steady, any movement there is being of the usual downward tendency. Importers are, of course, still severely restricted by the licensing regulations.

Around the Works: (1.)—British Dyestuffs Corporation, Ltd.

BEING the largest dyestuffs manufacturing concern in the country, British Dyestuffs Corporation, Ltd., controls several works, of which the principal is at Dalton, Huddersfield, others being at Blackley, Ellesmere Port and Clayton.



AIR PHOTO OF DALTON WORKS, HUDDERSFIELD.

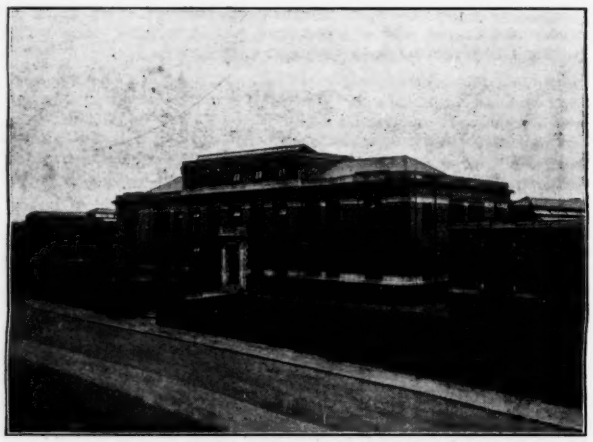
The Dalton Works have been erected since the formation in 1915, with Government participation, of British Dyes, Ltd. This firm bought the works at Turnbridge, Huddersfield, of Read, Holliday and Co., which had been making colours since 1860 and other chemicals since 1830. The B.D.C. was subsequently formed in 1918 by the amalgamation of British Dyes, Ltd., and Levinstein, Ltd., which firm had been making dyestuffs since 1860. Levinstein, Ltd., had already purchased Claus and Co., and thus incorporated another firm that traced its business history back to Perkin and Co., the originator of aniline colour manufacture.

Dalton represents the modern type of organic chemical works and is equipped with a central steam raising plant and the latest turbo-electric generating units, the "bleeder steam" from which is used in manufacture. The process of heating is by gas from Mond producers, which ensure regular temperature control. The works manufactures its own ice, and the plant for this purpose has a capacity of 100 tons per 24 hour day. The manufacturing sheds are symmetrically laid out, in order to serve the convenient handling of the raw materials, intermediates, etc., the works being served by an internal railway system. Besides acids—for which there are both oleum and nitric acid plants—and inorganic materials, all types of intermediate products and a wide range of dyestuffs are produced at Dalton, including azo colours for both cotton and wool, triphenyl methane colours and anthraquinone dyestuffs. There is also a well-equipped engineering workshop, including a brass and lead foundry, joiners' shop and cooperage.

The whole of the technical direction of the Corporation is centralised at Blackley, Manchester. These works were formerly owned by Levinstein, Ltd., and now cover an area of 100 acres, the greatest length being one and a half miles, containing 55 manufacturing sheds and numerous storage warehouses.

Here, also, are the Fine Chemical Department which has an ever increasing output of fine organic chemicals, medicinal products, indicators and microscopic stains, and the plant where the now well-known "Vulcafor" rubber accelerators are manufactured. The modern and well equipped laboratories of the Research and Dyehouse Departments are also at Blackley, and it is in these that matching of colours and the technical problems submitted by dyestuff users are dealt with by the technical staff. The Corporation now employs 125 chemists, 30 colourists, 30 engineers, and about 3,000 workmen.

At Clayton Works, Manchester, formerly owned by Claus and Co., all vat colours are at present manufactured, but it is intended to transfer them to Dalton Works in the near future. The last, but by no means least in importance of the Corporation's works, is the Ellesmere Port factory on the banks of the ship canal near Birkenhead. At the present time this is the only place in the country where synthetic indigo is made, and the factory supplies not only the whole of the home market, but has in addition a large overseas trade, particularly in China.



DYEHOUSE AND RESEARCH LABORATORIES, BLACKLEY.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, 8, Bouverie Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users af dyestuffs, and contributions on current problems will be welcomed

Our Dyestuffs Supplement

IF we ever had any doubts as to the need for the *Dyestuffs Monthly Supplement* as a new medium at the service of both manufacturer and user, these were entirely dispelled by the reception accorded to the first issue published in January. Not only did it have the immediate effect of stimulating interest in current dyestuffs problems, as was evidenced by the extracts from it quoted in many of the leading newspapers, but it afforded a platform for discussion of the controversial situation in which the industry at present finds itself. To recognise that opinion on these important questions is acute, however, is not to endorse or encourage unhelpful criticism, as we pointed out last month. Among the other features that attracted considerable attention was our special review of technical advances during 1925, and we hope to be able to arranged for regular technical comment on dyes and their application, the first instalment being published in this issue.

Other Points of View

THE article by Mr. Sutcliffe Smith on the dyestuffs industry from the users' point of view, which appeared in the first issue of our dyestuffs supplement a month ago, attracted widespread interest in the industry and in the Press. We welcomed it as an able and a timely statement of one aspeof ct the case, but always kept in mind, what some of our correspondents have overlooked, that it *was* in the main one aspect of the case that Mr. Smith's contribution represented. That, in fact, was its merit; some may retort it was also its defect. Perhaps so; but, as we pointed out at the time, in referring to Dr. E. F. Armstrong's evidence before the Committee on Industry and Trade, "it is only by getting the problem studied from various points of view that it can be seen in the right proportions." In recognising the excellent service Mr. Sutcliffe Smith had rendered, we recognised also that "there are several other factors to be taken into account."

The attempt by any party to a keen controversy to be strictly judicial and impartial and to represent all interests usually fails, though the intention may be faultless. Where, as in this case, there are sharply defined interests and points of view requiring to be reconciled, the best method is usually to have each aspect in turn stated by some one who thoroughly understands it. When all have been dealt with in this way, the intelligent observer has the material for forming a judgment and is able to get the position in the right perspective.

The Makers' Case

THE service that Mr. Sutcliffe Smith rendered last month to the users Major Holliday renders in this issue on behalf of the independent makers. On the personal side he represents interests and associations that go far back towards the birth of the British dyestuffs industry; on the commercial and productive side, the position of his company is typical of the private enterprise which, out of its own resources, without extraneous government or other aid, has succeeded in producing dyestuffs for British users and even in successfully competing with foreign makers in other markets. His case shows how desirable it is to defer judgment until one has heard the other side. His first paragraph recalls the atmosphere and the circumstances in which the question of establishing a national dyestuffs industry was being discussed just over ten years ago. Then the country was prepared for any sacrifice required to make our textile and other colour-using industries independent of Germany. It was the one appeal which, whether coming from the scientist, the textile manufacturer, or the politician, could be relied upon to elicit cheers. In response to this national demand very large sums of money were invested in dyestuff plant, etc., and those who did that are entitled to friendly consideration now. To the question whether the desired end is being attained, the answer we have more than once given is that ten years ago no one would have dared to predict the progress that has in fact been made. Defects and mistakes in detail, no doubt; but Major Holliday definitely claims that not only are the national objects being attained, but at a sacrifice much below that of any other nation.

"Tactical" Competitive Prices

As to the question of prices, it is clear that other factors than the efficiency of British production have to be considered. There are still, as Major Holliday states, quantities of reparation dyestuffs floating about on the Continent at fictitiously low prices. More than once we have drawn attention to offers from French sources of reparation colours, at prices greatly below the cost of production; some of these offers followed the seizure of German dyestuff works, and one can merely speculate as to how the stocks were obtained. Competitive prices, again, may be tactical rather than economic prices. We recall some instances given by Mr. Morton, of Scottish Dyes, Ltd., in which Germany charged the British user a high price for a dye not produced here; when a British maker produced an equal dye at the same or a lower price, the German quotation was instantly lowered to kill the British competition. The user must not, of course, in selecting such examples as alizarine or indigo to support the demand for cheaper products, lose the distant view. While the British user has an independent source of supply at home, the foreign producer will no doubt tempt him with attractive terms; if the home source of supplies ever ceased, the position of the foreign producer might suddenly change from that of suppliant to that of dictator. It is that danger that user as well as maker must keep in mind.

Enter the Colour Wearer

So much attention has been given to the interests of user and maker in the dyestuffs controversy that the point of view of the wearer—the ultimate consumer—has almost entirely been obscured. The other reply to Mr. Sutcliffe Smith that we publish in this issue, from a correspondent representing this last and most important class, is therefore of special interest, for whenever Mr. Everyman indulges in a new suit or gives way to his womenfolk's wishes for another gown, he is actually paying for the activities of the manufacturer and the dyer.

With regard to the necessity of maintaining and developing the British dyestuffs industry to the full, our correspondent has in mind the national considerations discussed in the preceding paragraph. The war having made it necessary for this country to build vast colour making plants that rival those at Ludwigshafen and Leverkusen, it is essential, he argues, that these be occupied as fully as

circumstances will allow. The British manufacturer must not be burdened with the excessive overhead charges that inevitably result from any but full-time production, and while the demand is not equal to productive capacity, there is no reason why our industry should suffer for the benefit of its foreign competitors. Despite the price penalties that the dyers have in some instances had to pay while the British dyestuffs industry is being established, our correspondent contends that the profits of some of the leading dyeing interests indicate, fortunately, that the condition of this branch of the trade has not been without steady improvement. In other words, he suggests that the Dyestuffs Act does not in practice appear to have greatly prejudiced the users' position, while at the same time it is enabling this country to build up a dye-making industry which, after seven years only, has gone a long way towards rivalling those of continental competitors.

New British Colours

WHILE disputation continues respecting many incidental aspects of the British dyestuffs industry, the really important business of producing new colours goes quietly and steadily on. Two examples of this progress have just reached us—an extended form of pattern card showing the application of the well-known Caledon colours produced by Scottish Dyes, Ltd., to cotton piece goods, and a second edition of the very attractive volume of acid colours on woollen yarn, issued by the British Dyestuffs Corporation. The Caledon colours belong, of course, to the vat series, distinguished for fastness, and they represent the very fastest members of this group. They find their chief use on cotton, both for dyeing and printing, but are also applied to linen, silk, and artificial silk, and in tinting paper, etc. The present card shows no fewer than 24 colours in the Caledon series dyed on cotton piece goods, and of these six are additional colours—Caledon Brilliant Blue R, Gold Orange R, Orange RRT, Red Violet 2RN, Red 5B, and Olive R. By varying the strength of the dye a wide variety of shade is possible. This is especially noticeable in such colours as Blue R, Green B, Purple R, and some others. The dyeing is carried out in the caustic soda-hydrosulphite vat in the usual manner, and the finished effect is distinguished for clearness and brightness of tone.

The acid colours on woollen yarn, illustrated in the B.D.C. index, represent quite another branch of the dyers' art. Here the colours, numbering 190 named shades, are shown on fairly coarse woollen yarn, and the effects are singular for their combination of warmth, softness and brilliant colouring, particularly in the yellows, scarlets, reds, violets, and blues. The ten typical mode shades, which appear to be the latest additions, represent charming gradations of colour, while the blacks and greys are distinguished for their soft depth. The dyed yarns here shown are capable of a great variety of uses. They illustrate the wide possibilities that wool, no less than artificial silk and cotton, presents for the generous application of colour, and the brilliant effects that woollen fabrics can carry, when rightly treated.

A British Fashion Display

FINANCED by leading members of the wool textile trades, the movement to establish London as a fashion centre entered the final stage with the opening of the British Model House by the Duchess of Portland on January 27.

Situated at the corner of Regent Street and Cavendish Place, the British Model House is a six-storey building, containing a reception room, theatre, ballroom, designing rooms, photographic studio and stock rooms, and is entirely devoted to the display by mannequins of the latest creations for the adornment of Eve. At the head of the large staff of designers and artists is Mr. Leslie Raymond, and ample space is devoted to workrooms for tailors, embroiderers and similar workers. Accessories such as millinery, shoes and stockings are also catered for, and it is understood that the display is not confined to wool fabrics but rather seeks to use all textiles, provided, of course, that they are of British origin. This is a step in the right direction, and will enable the British and foreign buyer to see British materials, designs and shades under the best conditions and in the most central and most attractive city in Great Britain.

The leadership (one might almost say the dictatorship) of Paris in matters of feminine fashion carries with it great advantages to the French textile manufacturer and textile dyer, not the least of which is the natural gravitation of the world's best ideas of colour and design to Paris, the best market for such wares. It is a bold challenge and deserves the support of all buyers for the home market who, after all, depend upon the prosperity of Great Britain and therefore, to a very considerable extent, upon the success of the great British textile industries for the sale of the products they buy.

Russian Boots

THE demand for coloured light upper leather, chiefly glacé kid and to a lesser extent willow calf, to meet this winter's demand occasioned by the popularity of the Russian boot, found the British leather dresser entirely unprepared. The irony of it is that the Russian boot is essentially a British fashion, but the coloured light (as distinguished from black) leather required is a phase of the leather dressing business which has been neglected by the British leather dresser, with the result that he is not in possession of enough knowledge to take immediate advantage of the large demand. His American and French competitors have been provided with an opportunity to dispose of large stocks of coloured leathers, unfashionable and therefore unsaleable in their countries of origin, and at a knock-down price which, unfortunately, leaves the British manufacturer no margin of profit. It is hoped that the fashion will be in vogue next winter, in which case there is no doubt that the British leather dresser will take full advantage of the position.

A New Colour Instrument

A SCIENTIFIC instrument of quite unusual interest was described last week at a meeting of the London Section of the Society of Dyers and Colourists. The lecturer, Major Klein, outlined the inconveniences to which designers have previously been put in trying out colour schemes, involving in many instances quite arbitrary "rule of thumb" methods, but which now promise to be obviated by use of the "Mutochrome." As its name implies, this is an instrument for changing and transposing colour combinations, a picture of the pattern or design being projected in colour on to a screen, and each element being independently variable. The Mutochrome is also a camera, and is first used to photograph the design.

Briefly stated, the method adopted is to produce on different parts of the same photographic plate a series of transparencies, each of which corresponds to one element of the design. These images are then projected on to a screen through separate lenses in such a way as to "mesh" accurately. Any individual element can then be coloured up in any desired manner by the insertion of a filter in front of the corresponding lens, the adjustment of an iris diaphragm controlling the brightness or "depth" of the colour. The colour filters can be correlated with any existing range of colours so that, if the design is projected on to a piece of the material to be dyed, a complete optical illusion of the finished product is obtained. A demonstration of the instrument was given during the lecture, which appeared to substantiate the remarkable claim made for it by the inventors. S

The Dyestuffs Situation: From the Makers' Point of View

By L. B. Holliday

In the first issue of our "Dyestuffs Monthly Supplement" (January 9) we published a review of the British dyestuffs situation rom the users' standpoint by Mr. H. Sutcliffe Smith, chairman of the Colour Users' Association. In the following article Major L. B. Holliday discusses the subject from the British makers' point of view.

It seems to me a very natural thing that the user of dyes should continually tend to slip back into a narrow and parochial way of thinking about the dyes question, forgetting the time of privation through which he once passed, and that the question of dyestuff supply is not one of a penny a pound more or less, but is of first rate national importance.

The several defensive key-industry and educational arguments for the establishment of a dye industry still hold, and with undiminished force. To my way of thinking, the one question to keep before ourselves is this: "Is the end being achieved which this country set out to attain? Are we or are we not developing in this country an efficient dyestuff manufacturing industry?" I say without hesitation that we are and that we are achieving it at a less cost than any other nation. The only other country which has made so serious an attempt as ourselves to found a dye industry is the U.S.A. But in that country, not only have they instituted a more drastic licensing scheme than our own, but they have maintained an import duty of 40–45 per cent. *ad valorem* plus 7 cents per lb. This means that, in order to attain the same object as ourselves, the American public has been willing to make much greater sacrifices than have been called for in this country.

Major L. B. Holliday.

The main effort of research has hitherto been necessarily occupied with the known requirements of trade; but we are sure that as these are satisfied, the energies of British chemists will quite certainly be breaking new ground again, and that we shall not have to wait long for further results. It must not be forgotten that even in existing circumstances original research has been by no means neglected; I suppose that with the various series of dyes for acetate silk, the very interesting new vat dyes, new Pyrazolon dyes, etc., upwards of 50 quite new products have already been marketed, and I know of some others which will be launched in the near future.

I have had foreign visitors in my works who have been absolutely incredulous when shown the results of six or eight years' work; yet our colour using friends damn us with faint praises and manipulate statistics to our disadvantage as though they were nursing a grievance. This is not constructive criticism; it is hinting at failure. Instead of this, a calm examination of the steady progress of the industry in the extent and quality of its product, as shown, for example, by Board of Trade returns, should have drawn Mr. Sutcliffe Smith's enthusiastic approbation, if the colour users are really serious in their desire to assist the success of this national effort.

It seems to me also that when the price of a foreign dyestuff has been reduced in case after case by the entry of British made dye into competition with it, the industry does not get the credit which it has a right to expect. It is always the other side of the picture that is emphasised, and especially the cases of alizarine and indigo, which are exceptional. Furthermore, with regard to the foreign prices of dyewares, it must always be borne in mind that all over Europe there are still quantities of French and Belgia reparation dyestuffs which are sold much below the economic value. With regard to the prices quoted by German and Swiss manufacturers, we are perhaps rather better informed than many users, by reason of the fact that we are and have been for some years competing with our British made products in all continental countries, and competing directly and without fear or favour with the German and Swiss—except in Germany itself where dyestuff import is barred.

With regard to the relation of prices, we find it less easy than Mr. Sutcliffe Smith to generalise so conveniently. The prices vary a good deal between one country and another and between one firm and another; but we can assure him that we can often obtain better prices for our products abroad than he himself would be prepared to give us, and that generally speaking, where a British product is well established, it can usually be made and sold in fair competition with the world, provided that the over-capitalisation resulting from war-time construction has been got rid of.

I consider the latter point to be very important. The reduction of capital which the Government has enabled the British Dyestuffs Corporation to effect by the cancellation of its shares at their slumped value, must be of help towards economical working. It might have gone farther still. The same process may be just as necessary in other quarters of the industry where, however, the banks are not so obliging as the Government in cancelling overdrafts on account of slumped values; and it must be remembered that the individual firms in this country, other than the British Dyestuffs Corporation, provide over 60 per cent. of the total dye made here.

Mr. Sutcliffe Smith asks for enlightenment as to why the factor of 250 per cent. on pre-war prices is maintained for dyes as compared with the index figure of 155 per cent. covering the wholesale prices of general commodities. In my opinion the comparison is unfair, and tries to demonstrate a bigger difference than in fact exists; while for the small difference which does exist there are two or three good reasons. I suggest in the first place that a fairer comparison would be between the factor expressing the actual average price of dyewares in this country to-day, *i.e.*, taking into consideration all dyewares that are sold at extremely low prices, some of the prices being equal to those of pre-war days, and others not being much higher, and comparing this with the cost of living factor in this country. As the cost of living factor is 177 per cent., and the average price of dyewares used in this country to-day wh ch were used pre-war would probably be below 200 per cent., it is easy to see the difference is very much smaller than that indicated as between 250 and 155 per cent., the 250 per cent. being the maximum figure at which licences are granted for the few specialities that still have to be imported.

Whatever difference there may be is due, in my opinion, firstly, to the entire change in conditions. No one, not even

the Germans, who have lost at least 50 per cent. of their markets, can get back to the mass production of pre-war times. The task of the Germans to reduce overhead charges in proportion to their lost markets is a stiff, if not impossible one; and although the co-ordination of seven factories under one direction looks promising on paper, the practical difficulties of reducing the cost of management when the factories are even less widely separated than in Germany are very great, as our own British Dyestuffs Corporation have experienced.

Secondly, it must be remembered that the pre-war prices of many dyes were at absolutely unremunerative levels, even under the conditions of mass production prevailing.

Lastly, there is the question of raw materials. The absence of really comparative pre-war figures often makes it difficult to estimate differences; but to take only one example, though a very important one: it is certain that anthracene, the raw material for a constantly increasing proportion of our dyes, costs somewhere round four times the pre-war figure, and from material at this cost it is obviously impossible to make alizarine, acid alizarine or vat dyes at one and a half times pre-war price, as Mr. Sutcliffe Smith seems to expect.

With all that Mr. Sutcliffe Smith writes about research, co-operation between maker and user, and co-ordination between the various makers, I am in cordial agreement. There is undoubtedly a great deal of overlapping. This could doubtless have been avoided if the British Dyestuffs Corporation had taken the lead in the matter or had been more willing to co-operate with outside makers, instead of rather ignoring them. But whatever may or may not be possible in this direction, I am convinced that the hard work that has been put in by the dyestuff makers will not be lost to the country. One cannot be so certain about the hard cash the makers have sunk in the industry. But come what may, there is already a very considerable and, to use Mr. Sutcliffe Smith's word, a "virile" industry established and one which has not yet ceased to improve in efficiency, diversity, and quality of production.

The Colour Wearer and the Price Factor

A Reply to Mr. Sutcliffe Smith

In addition to the article by Major Holliday, we have received the following statement from a correspondent, obviously well-informed commercially, who speaks for a new third party, the dye wearer, and who examines sharply and in some detail the users' complaints on the question of price.

In the course of the discussion on the British dyestuffs situation much has been heard of the interests of the maker and of the user, but scarcely any mention has been made of the interests of a very important third party—the dye-wearer, who is the ultimate customer of both the maker and the user and who remunerates both for their service in the price he has to pay for his clothes. From this detached point of view, therefore, something ought to be said on Mr. Sutcliffe Smith's contentions on the question of British dyestuff prices.

A little consideration will show that dye wearers are acutely interested not only in the prices of dy wares, but also in the cost of their application to textiles in general. The burden of Mr. Sutcliffe Smith's article is the enormous financial sacrifices made by colour users in order to establish a home industry in the manufacture of synthetic dyes. No one conversant with the facts of the situation denies that dyers are, on the whole, paying more for their dyes than before the war. A partial explanation of this increased cost is that the dyers are, in many instances, using superior, faster, more permanent, and more expensive dyes. Moreover, there is the general post-war increase in the cost of all commodities.

Dye Users' Profits

In the case of great dye using combinations, such as the Bradford Dyers' Association, this extra cost of dyes is a serious matter and runs into tens of thousands of pounds sterling annually. But the object of these great financial sacrifices is not entirely philanthropic, as is seen by the trading returns of the great dye-using combinations. A general survey of their balance sheets shows that fortunately the financial sacrifices have not prejudiced the commercial success of these great national businesses. For example, during the post-war years the dividends of the B.D.A. have been declared as shown in the following table, the pre-war and war-time dividends being added by way of comparison:

Pre-War.	Per cent.	War Time.	Per cent.	Post-War.	Per cent.
1910 ..	5	1915 ..	10	1919 ..	22½
1911 ..	6	1916 ..	15	1920 ..	20
1912 ..	6	1917 ..	17½	1921 ..	10
1913 ..	7	1918 ..	17½	1922 ..	35
1914 ..	5			1923 ..	25
				1924 ..	25

These distributions have been made only after generous contributions for the benefits of the workers of the Association, and after making liberal allowances for the depreciation of plant and other assets. The aforesaid contributions involve sums of the order of £130,000 per annum, and the annual allowances for depreciation are over £200,000.

No fair-minded critic would wish to complain of these halcyon conditions obtaining in one of the principal branches of our textile industries. But they scarcely bear out a tale of unrequited sacrifice.

The published balance sheets of the B.D.A, indicate, on the contrary, that as regards increased cost of dyes the Association is frequently in the happy position of being able to pass it on.

On the rare occasions when the financially embarrassed Mr. Everyman indulges in a new serge suit, or whenever in a moment of generosity, quite unwarranted by his pecuniary circumstances, he yields to his wife's and daughters' requests for gowns in fashionable spring shades, he is doing his bit towards the maintenance of the above-mentioned social and financial benefits in one or other of our dye-using industries.

It would be of the greatest interest to dye wearers and dye consumers to know how far the greatly increased costs of dyed and finished textiles are attributable either to the operation of the Dyestuffs Act or to the alleged shortcomings of British dyemakers. It is significant that before the war the great dye-using combinations were not paying anything like the dividends which they now distribute.

To take one colour which has been mentioned on several occasions in this connection, the history of Patent Blue is interesting in its bearing on the price problem. Before this colour was available from British makers the dye-users were paying without any outwardly expressed dissatisfaction 20s. to 25s. per lb. for this colour imported under licence.

B.D.C. Effects Reduction in Prices

When the British Dyestuffs Corporation first commenced to manufacture this very complicated dyestuff, so far from availing themselves of the protection of the Act they put their product on the market at 12s. 6d. per lb., and shortly afterwards at 8s. 4d. for bulk orders. Their price has since fallen very considerably to about 3s. per lb. This example illustrates clearly a well-known practice on the part of foreign competitive dye-makers. The British users were paying a very high price for the imported colour until the English firm initiated a cut of 50 per cent. This reduction was then met by a considerable fall in the price of the foreign dye. It is a fair inference to draw from the facts that the enterprise of the B.D.C. had a very notable effect in reducing the cost of this dye to the user.

Although one ought not to make general deductions from isolated examples either on one side or the other, yet the cases of Patent Blue and similar colours have had an important and wide bearing on the prices of imported (non-contentious) dyes. The British firms are competing so keenly in the market for home made (contentious) dyes that would-be importers of non-contentious dyes are having to quote very close prices

for these colours in order to get any importation. At the present time, it is stated that the prices are slightly heavier for the contentious than for the non-contentious colours. One colour maker's estimate is that the difference amounts to about 4 per cent., which is not a very onerous charge on the prosperous dye-using industry.

Mr. Sutcliffe Smith complains that the Act maintains an index figure of 250 for the bulk of British dyestuffs, but evidently being a little doubtful as to the accuracy of this suggestion, he adds immediately that many dyewares are sold by the British makers at under the factor of 2½ times pre-war.

That the latter statement appears to represent more correctly the existing state of the trade, however, is supported by evidence given recently by Dr. E. F. Armstrong before the Government Committee on Industry and Trade. (See THE CHEMICAL AGE Dyestuffs Supplement, January 9, p. 4.) His figures showed that French and Italian dye users were actually paying more for their dyes than were their British competitors. Dr. Armstrong also contraverted the assertion that the high price of dyes is responsible for the diversion abroad of trade in finished goods.

Mr. Sutcliffe Smith asserts that the Dyestuffs Act limits the freedom of users in regard to access to the world's latest progress in dyewares, assuming somewhat unfairly that these novelties will always come from foreign dyemakers. At the present time at least four of our dye-making firms are in possession of novelties discovered not on the Continent but by their own chemists, and in certain instances these British inventors have granted licences to foreign dyemakers enabling the latter to manufacture the British novelties on payment of royalties.

Mr. Sutcliffe Smith does not appear to think it necessary for British dyemakers to make any profit at all, for he cites indigo and alizarin as "instances of a glaring character," in which the makers have endeavoured, but not very successfully, to maintain prices on the basis of a margin of profit.

Bulk Business for Germany?

The most serious implication in Mr. Sutcliffe Smith's article is, however, contained in the following passage:—"The Germans candidly admit that for non-contentious dyewares for which we receive licen es to import, the prices charged to us are not nearly so low as we should pay for them were we able to place bulk business as before the war."

This passage with its slogan of *Bulk Business Wanted*—for the Germans—must be commended to the careful consideration of all who have the interests of British chemical industry at heart, including in this category the writer of the editorial who eulogised Mr. Sutcliffe Smith's point of view.

"Bulk business as before the war" means 80 per cent. of imported dyewares and only 20 per cent. of home manufacture. At present the figures are reversed, the imported (non-contentious) dyes are only 20 per cent. whereas the remaining 80 per cent. are home made, and Mr. Sutcliffe Smith cannot have it both ways at the same time.

Was it to make bulk business for Germany that the cry was raised during the war of "never again"? If we are again to dwindle to a 20 per cent. home production where was the sense of building at Huddersfield the great Dalton works rivalling in extent those of Leverkusen and Ludwigshafen? If they are not to retain their present 80 per cent. production, what is the use of British makers "getting on to a new plane by the introduction of more and more entirely new products originated as the result of their own research"? They have done so already to a very appreciable extent, but if their reward is to be bulk business for their foreign competitors what attraction can there be in the suggested enterprise?

In seven years or less British chemists engaged in the dye-making industry have, with commendable zeal and doggedness, overtaken their Continental rivals who had had fifty years' start. One by one they have replaced the foreign importation by a British-made product. Although at first they had to imitate, they have not been mere copyists, and now they have assumed the offensive and are turning out new products and devising improved processes hitherto unknown abroad.

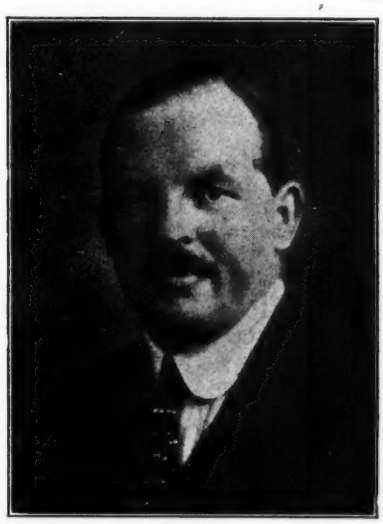
With these newly-acquired advantages the British dyemakers should have no insuperable difficulty in gaining "an adequate share of the export business," provided that their home and

(*Concluded at foot of next column*)

The Dyestuffs "Who's Who"

(2.)—*Dr. E. Frankland Armstrong*

DR. FRANKLAND ARMSTRONG, who was born in 1878, has not only maintained the academic prestige of his distinguished father, Professor H. E. Armstrong, but has also achieved unusual success in the world of industry. After studying at the Royal College of Science and the Central Technical College in London, he went to the University of Kiel and then to Berlin, where he worked under Professor van't Hoff and obtained his degree. He also visited the University of Copenhagen. On his return to England he was awarded the Salters' Company's Research Fellowship of the City and Guilds Institute, and started on his industrial career when he was subsequently appointed as chief chemist to Huntley and Palmer, of Reading. His scientific work did not terminate with his entrance into industry, however, and he now holds the degrees of D.Sc. (London), Ph.D. (Berlin), and is a Fellow of the Institute of Chemistry and of the Royal Society.



DR. E. F. ARMSTRONG, F.R.S.

After nine years at Reading, he joined Joseph Crosfield and Sons, Ltd., at Warrington, of which he became managing director in 1915. Until 1920 he held the same post in William Gossage and Sons, Ltd., of Widnes and Liverpool, and in a number of associated companies of these two firms throughout the world. In May, 1925, Dr. Armstrong was appointed managing director of the British Dyestuffs Corporation, and under his capable direction the reconstruction of the concern was carried out within six months of his appointment. It was recognised, when his appointment was announced, that he had entered on a task of unusual difficulty; but it was equally felt that he possessed the special qualifications required for the post. His appointment inspired the confidence, not only of the technical staff but of the public, and renewed in many quarters hopes of the Corporation's final success.

In the application of science to industry Dr. Armstrong has played an important part, having served as President of the Society of Chemical Industry and on the Councils of the Chemical Society and the Institute of Chemistry, and he is now President of the British Association of Chemists.

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colonial markets are effectively safeguarded against unscrupulous foreign competition.

These outlets for their products will enable our dyemakers to manufacture at full capacity, thereby reducing their overhead charges to a minimum, but in order that this economic condition may be reached and maintained, the bulk business will have to be secured to the home producers. Whether these hopes will be realised or not by this well-deserving scientific industry remains to be seen.

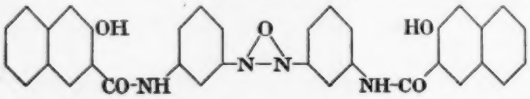
It is extremely difficult to fathom the motives which lead many prominent dye-users to maintain an attitude of censorious criticism concerning the alleged inefficiency of the dye-making industry, particularly as in certain instances 90 per cent. of the dyes they employ are of British manufacture. If the aim of this agitation is an immediate repeal of the Dyestuffs (Import Regulation) Act, it would be in the national interest to ascertain on what grounds and for whose benefit the withdrawal of this safeguarding Act is desired.

Dyes and their Application: Recent Technical Progress

Last month we published a review of developments in 1925 by a member of a leading dyestuffs manufacturing company. We are able to announce that we have now arranged with this special correspondent to contribute technical notes regularly.

AMONG recently patented azo colours, red to bluish red products are described by the B.D.C. (Saunders and Goodwin, E.P. 242,061). These are used for printing with a chrome mordant and are obtained by coupling substituted pyrazolones with naphthalene-1-amino-3-carboxy-2-hydroxy-6-sulphonic acid. Products of a similar type giving orange to bluish red shades on chrome mordants by coupling 1-naphthyl-3-methyl-5-pyrazolone with, for example, benzene-1-amino-2-hydroxy-5-nitro-3-sulphonic acid are given in U.S.P. 1,556,329 (A.G.F.A.). The preparation of a base for a new series of azo colours is described by Pinto. (*Comptes rendus*, 1925, 181–788.)

Complex derivatives of β-oxy naphthoic acid as, for example



may according to U.S.P. 1,558,890 (Cassella) be coupled with two molecules of a colour base; the compound above with *m*-nitro-*p*-toluidine giving a bluish Turkey red shade.

In *J. Soc. Dyers and Col.* (1925, 41, 354) the constitution of some of the products used for insoluble azo colours is elucidated by Rowe. Such information is always of particular interest as manufacturers do not generally publish the formulæ of new colours. The naphthol AS.BR. (Gr.E.) which is used as the basis of browns is probably the dianisidide of β-oxy naphthoic acid. Brenthol H soluble (British Synthetics, Ltd.) is a compound of pyridine and the anilide of β-oxy naphthoic acid. It is remarkable for its stability in the bath. Colour bases such as the fast reds, scarlets, oranges and yellow are various substituted anilides, toluidines, etc.

A very interesting paper on the mechanism of the dyeing of acetyl silk by Kartaschoff is given in *Helvetica Chim. Acta* (1925, 8, 928). Acetyl silk is a colloid with a negative electrostatic charge, but this does not influence the dyeing. The author carries out experiments to show that this is a solution phenomenon, recommending the amino anthraquinone dyestuffs (Celatenes, Duranols) for this purpose. Photo-micrographs are shown depicting first the adherance of the minute crystals of the dye to the fibre and then their gradual solution in the silk. In addition to dyeing in aqueous suspension in the normal way, skeins of the silk were left in contact with the dry dyestuff for several days at 60° C., and deeper shades were obtained than from aqueous baths. When the fibre was allowed to remain for 15 days at 73° C. it became friable, indicating that the base was dissolving the silk.

Acetyl Silk Dyestuffs

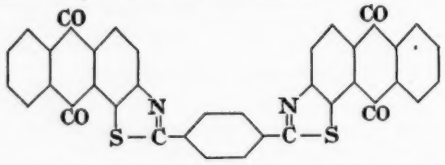
The B.D.C. (Perkins and Hollins) patent basic dyestuffs for acetyl silk in E.P. 244,267, which are nitro derivatives of amino anthraquinones, the amino groups being protected by acetylation before nitration. Thus 1·5-diamino anthraquinone is converted to the diacetyl derivative and then the nitro group introduced, the product after hydrolyses dyes brown shades. These results are interesting as there have been very few browns available in this series. Blue and brown azo dyes for the same purpose are described by S.C.I.B. (E.P. 220,303) by coupling unsulphonated nitro diazo compounds of benzene with monosulphonic acids of N-substituted anilines. These compounds, it will be noticed, contain a sulphonic acid group, and this in fact may be arranged to be in either constituent of the coupled product. Additional solubilising agents such as tetra chlor ethane or trichlor ethylene are used by the British Celanese, Ltd., in their S.R.A. colours (E.P. 242,711), these being used in addition to the previously patented substances, stronger and more level shades being claimed.

Finely divided pigment dyes are obtained (M.L.B. E.P. 240,852, open to inspection) by the use of resins or solid fatty acids in conjunction with the suspended colour when drying. It is also claimed that it is possible to eliminate the added substance after treatment and before drying without destroying the subdivision.

Economy in Intermediates

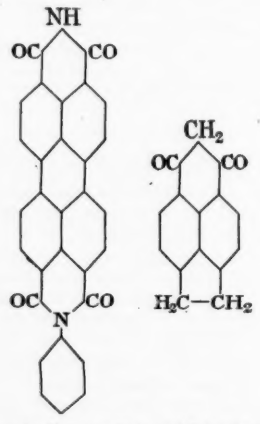
Economy in the production of intermediates is of especial importance under the present conditions of dyestuff manufacture. This tendency is seen in B.P. 243,505 (Thomas and S.D.L.) dealing with nitroanthraquinone derivatives. The final stage in the production of these from substituted benzoyl benzoic acids is one of dehydration, which in the majority of cases is most conveniently carried out in sulphuric acid. In the present patent the solutions thus obtained are nitrated directly and the nitrochlor or nitro methyl bodies mentioned as examples are afterwards isolated from the sulphuric acid.

The majority of the fast vat yellows give shades on the red rather than the greenish side of yellow. Yellow dyestuffs giving pure yellow tints were described in E.P. 204,249 (B.A.S.F.). An alternative method of preparing these is now given in E.P. 242,837, the condensation product from anthraquinone 1-halogen-2-amino and, for example, terephthaloyl chloride being treated with products yielding sulphur, instead of the sulphur being present originally as a mercapto group in the ortho-position to the amino. The constitution of the product is probably



Products containing sulphur do not, however, generally possess the highest degree of fastness to light.

The production of red dyestuffs from perylene was referred to in the summary of last year's progress. G.P. 415,711, (Kalle) describes the production of products from perylene tetracarboxylic acid mono imides and amines, giving mixed derivatives. A red shade is obtained with aniline, the product being



Derivatives of a similar type in which the perylene nucleus is replaced by naphthalene are foreshadowed in E.P. 240,859 (M.L.B.) at present open to inspection, which describes the preparation of naphthalene 1.4.5.8.-tetra carboxylic acid. The starting point is acenaphthene which already contains two carbon atoms in the necessary alpha positions in naphthalene, the other two are obtained by condensation with malonyl chloride. The resulting compound on oxidation with alkaline potassium permanganate gives the requisite four carboxylic acid groups.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Yorkshire

Bradford, February 11, 1926.

ENCOURAGING demand for dyestuffs did not characterise the opening week of the year; indeed, trade was distinctly dull. During the second week the outlook for the month improved, and it is now realised that January has been just the ordinary undistinguished sort of month to which we have grown accustomed. It is felt by the intermediate and dyestuff making concerns that the still closer organisation of the units of the Interessen Gemeinschaft is a matter that should cause the British dyestuff consumer to appreciate the value to himself of a virile home industry, and the necessity of taking every step possible towards efficiency and thorough economy, consistent with advancement, is fully realised. Rumour, the fabric of which has been the attitude of the Interessen Gemeinschaft towards the British Dyestuffs Corporation, and the revolutionising of the former's selling organisation, with its effect in Great Britain, has been active.

A result of the operation of the Silk Duties appears to be more detail in the work of the fancy yarn dyer and spinner. Where natural silk, easily dyed in brilliant colours, was previously employed, mercerised cotton, in as bright shades as the dyer can produce, is now being twisted with worsted for stripe effects in pieces. It is expected that Bradford will be well represented by a showing of yarns, which are extensively spun in the district, at the exhibition of British artificial silk goods to be held at the Holland Park Hall in April next. Although most of the woollen mills in Huddersfield are working full time there is a lull with regard to new orders, but this latter is looked upon as merely a temporary condition. It is reported that Canada is the only overseas country taking any quantity of pieces. In Dewsbury textiles are very depressed, short time being general, but there is an optimistic feeling that the Far Eastern business may improve. Manufacturers engaged mainly in winter cloths do not expect to receive orders for their next season's requirements until the end of this month or the beginning of next; the quietness is due largely to the present being "between seasons." Piece dyeing in Bradford continues to be fairly busy and warp dyeing slack.

Benzol is slightly easier than during December, with somewhat less inquiry for toluol and solvent naphthas; creosote remains in active demand. Little variation in the price of aniline oil has occurred and there is no change in that of dinitrochlorbenzene. Indications point to a fall from 3s. per lb. for metatoluylenediamine. Demand for nitrobenzene at 4½d. to 5d. per lb. is brisk and no change in the price of orthonitrotoluene is evident. The prices of benzidine base have suffered some little shock from the appearance in the market of ton lots offered at prices round about 2s. 8d. per lb. delivered carriage paid; there is still, however, inquiry for the better qualities at 3s. per lb. Sodium sulphide 60/65 per cent. solid, quoted in the home market at £11 10s. per ton in drums, spot, is occasionally threatened by the imported product at slightly lower prices.

Lancashire

Manchester, February 11, 1926.

January has, on the whole, been quiet, with some improvement towards the close. There is a poor demand from the cotton section, and the same may be said of the natural and artificial silk sections. The hat trade and the leather trade are quiet, although the paper trade is somewhat better. The only really healthy business has been in dyestuffs for the manufacture of colour lakes, no doubt based upon the continued prosperity in the building trade and the consequent demand for paints, wallpapers and distempers.

In such circumstances it is not surprising that prices for dyestuffs are generally lower, and in many cases so low that there can be very little margin left for the manufacturer.

The boom in Russian boots is not of much interest in Lancashire as glacé kid and willow calf are not dressed to any extent; on the other hand, the extended used of coloured leather for motor-clothing has led to somewhat increased demand for dyestuffs.

During the month British manufacturers have placed on the market equivalents for the German colours Pluto Black A Extra (Bayer), Acid Cyanine BF (Berlin), Permanent Red R, (Berlin), and Fast Light Red B (Bayer) under the names of Plutamine Black A Extra (North British Chemical Co.), Benzylene Blue (Brotherton), Permanent Red R (Major), and Lissamine Fast Red B (British Dyestuffs Corporation, Ltd.) respectively, all of which are valuable additions to the already extensive range of British-made dyestuffs.

Midlands

Leicester, February 11, 1926.

Since the appearance of the January dyestuffs supplement, nothing of outstanding interest to the dye manufacturer has taken place in the Midlands. One still hears something of the hardships caused by the higher prices charged for dyestuffs in England than in some foreign countries—some even go so far as to talk of diversion of trade from this cause. To anyone at all conversant with facts, however, such statements are too ridiculous for words, particularly at the present time, when the darkest hosiery shades are little more than tints—nevertheless they are spoken and not infrequently printed. If they were really true, what a terrible calamity awaits us if wrapping paper makers advanced prices by 5 or 10 per cent.!

The Midland Hosiery Dyers' Federation have reduced their prices recently by about 30 per cent. If the cheap dye cry holds any water, one can visualise the 20 miles of good hunting country that separates Nottingham from Leicester being very quickly covered with hosiery factories. This, however, is not the aim of the Federation, whose motive is to get the whole of the hosiery commission dyers to join the Federation. Meanwhile, hosiery manufacturers can afford to smile as they are getting a good proportion of their dyeing done at or under cost.

Real silk and cotton hose is now coming along in small bulk, and judging by the amount of plant that is being or is about to be put in for this class of work, it would appear that Mr. Churchill's Silk Tax has had the desirable effect of starting a new and important branch of the hosiery trade. If the ladies will come to the rescue by wearing deeper shades, there will be a demand for dyes suitable for this class of work. The method of dyeing these goods mentioned in the last Dyestuff Supplement is the one almost universally adopted and the dyeing of silk and cotton hose, although previously only done in small quantities and by very few dyers, appears to present no difficulty. If dyers take advantage of the technical service offered by the principal dyemakers we need not be behind other countries as far as dyeing is concerned. Artificial silk and cotton hose, which has recently suffered its first reverse for many years, shows signs of recovery. Knitted woollen fabric for jumper suits and pullovers is still in fair demand, although the yarn for this work is not by any means all of local manufacture, and does not materially affect dyestuff sales here. Cashmere hose and half hose are coming along in small quantities and keep dyers fairly busy on a small output.

The lace trade in Nottingham area is very depressed, garment dyeing also being extremely dull, as is usual during the months of January and February. Some dyestuffs are being quoted at slightly lower prices than a month ago. A few products have received special attention as regards price cutting, levelling reds in particular.

Scotland

February 11, 1926.

The general feeling in the textile, dyeing and dyestuff making trades in Scotland remains substantially the same as at the end of last year. That is, while the bulk of the trade is still experiencing a dull time, in one or two sections more favourable conditions prevail, with fairly good prospects for the next few months. This is perhaps particularly the case with the

wool trade of the Border. Reports from Hawick show that there are hopes that the good conditions that have ruled during the last six months may continue. Conditions at Galashiels, Peebles, Walkerburn, etc., are very much better than they have been for some time past.

Dyeing on the whole is dull, especially in the piece and yarn sections. With wool there has been some activity corresponding to the improvement in the wool trade. The UnitedTurkey Red Co. have been experiencing an all round improvement at their branches, but the Calico Printers' Association have quietened down.

The Pritchard process for flax, which was originally intended to be started in the neighbourhood of Glasgow, is actually to be worked at Rosyth. This latter will be a much better situation with regard to the flax industry generally. Moreover, any industrial additions of this kind will be particularly welcomed by Dunfermline as counteracting, if only to a slight extent, the loss due to the closing down of Rosyth. Works will probably be leased from the Admiralty for the purpose, as plenty of these are available and new building will not be necessary.

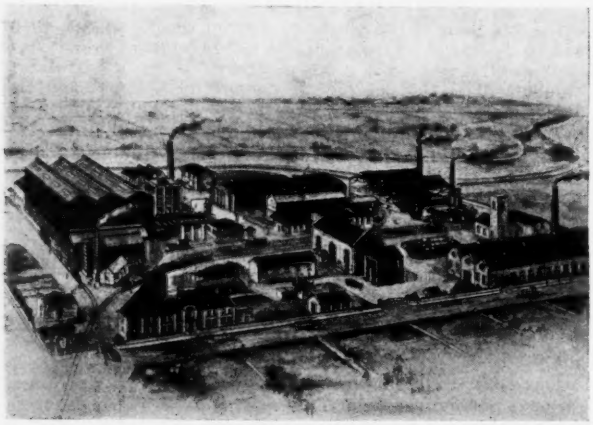
Dyestuff inquiries remain much as they were. January, as usual, was rather a broken month, but February appears to be opening promisingly. Reports from Glasgow indicate some little interest being gradually taken in vat colours for wool, and inquiries are also being made for suitable machines for the dyeing of loose wool. No outstanding features are to be recorded.

Around the Works

(2.)—Hickson and Partners, Ltd.

THE works of Hickson and Partners, Ltd., were erected at Castleford in 1915 at the instigation of the War Office for the purpose of manufacturing T.N.T. The founder of the company, Mr. Ernest Hickson, had previously owned chemical works at Wakefield, but these were not adequate for the output required, and a new site was found on the banks of the River Aire, just below its junction with the Calder, giving a frontage for quays of some 650 feet and offering facilities for railway sidings direct on to the London and North Eastern Railway. The first sod was cut on January 22, 1915, and building was pushed on with such speed that a first delivery of finished T.N.T. was made on July 13 of that year.

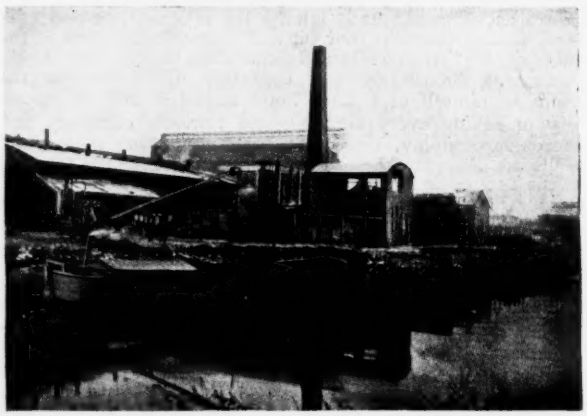
The founder had been intimately connected with the aniline



GENERAL VIEW OF CASTLEFORD WORKS.

colour trade since the earliest days, being with the first large makers of aniline dyes in the world, Messrs. Brooke, Simpson and Spiller, Ltd., of Hackney Wick, London, since 1877, and the new works was so designed at its inception that it could be eventually converted into a self-contained colour factory, capable of making its own intermediates and dyes and only dependent on other sources for crude basic raw materials, such as sulphur, crude benzol, etc. For this purpose, after it had been found impossible during the circumstances prevailing in 1915 to rush up an oleum plant quickly, a large sulphuric acid chamber plant—believed to be the largest unit of its kind in the United Kingdom—was erected to a modified Belgian design. Sulphuric acid is, of course, one of the most important raw materials used in the works, and being able to make this on site and pipe it to the various departments using large quantities, places the company on an exceptionally strong economic basis. A large plant for nitric acid was added and another for the rectification by fractional distillation of coke oven benzol. By this means all the essential raw materials required at that time were produced in the works.

When the war ended, the plant was gradually turned over



WORKS' QUAYS ON RIVER AIRE.

for the manufacture of intermediates, chiefly nitro and amido derivatives of benzene, toluene and xylene and the further working up of some of these products into more complicated compounds, and some finally into dyes. A speciality has been made of nitrobenzene, aniline, ortho- and para-toluidine, and among dyestuffs, sulphur blacks and magenta and rosaniline base for the production of soluble and alkali blues. Sulphur blacks first came into the market after their discovery in 1893, and Mr. Hickson has been intimately associated with their production and sale since the original discoverer, M. Vidal, first made them in England. He was able to secure the patent rights of the latest improvements, invented just before the armistice, in this very important range of cotton dyestuffs, and the company placed these on the market under the name of Vidal Victory Black.

The development of the present works has taken place largely under the supervision of the founder's son, Mr. Bernard Hickson, M.Sc., who inspected practically all the large nitrating factories carried on during the war, and as a member of the mission appointed by the Department of Overseas Trade, which was sent to Germany in 1919, had a unique opportunity of studying the organisation, lay-out and working of the plant of foreign colour works. The policy of the firm is to specialise on comparatively few products, all of which are made in the works from crude raw materials, and to be independent of other makers for intermediates.

B.D.C. Appointment

IT was announced this week that Dr. Alfred Rée has accepted an invitation from the directors of British Dyestuffs Corporation, Ltd., to join the board of that company.

Dr. Rée was formerly in business as a chemical manufacturer. For the last two years he was president of the Society of Dyers and Colourists, and he has been an active member of the Association of British Chemical Manufacturers, of which he was one of the founders, since its formation in 1916. As a director of the Manchester Chamber of Commerce for many years and president of that body for the last two years, Dr. Rée has been brought into close contact with the commercial and industrial requirements of that city.

Following the resignation of Mr. Alexander W. Scott, who had in his charge the home sales department of the British Dyestuffs Corporation, Ltd., the whole of the commercial functions of the Corporation have been merged, and Mr. S. Whetmore has been appointed commercial manager.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users af dyestuffs, and contributions on current problems will be welcomed*

The Question of Dyeing Charges

THE remarks of the chairman of the Bradford Dyers' Association, Mr. George Douglas, at the annual meeting held a fortnight ago, on the question of dyeing charges were undoubtedly intended to be a reply to the criticisms made, amongst others, in our Dyestuffs Supplement for February. It will be recalled that Major Holliday resented the users' point of view as put forward by Mr. Sutcliffe Smith in a previous issue (January 9) and refuted the charge that, taking every factor into consideration, the prices of British dyestuffs were higher than circumstances justified. In discussing the price factor from yet another standpoint, a "Colour Wearer" suggested that the handicaps consequent upon the increased costs of dyed and finished textiles were not so much due to the higher prices of dyestuffs as colour users maintained, the trading results of the Bradford Dyers and other great concerns at any rate indicating that business was steadily improving in their branch of the trade.

Speaking of the relative position of the export of cotton piece-goods under the various categories of grey, bleached, printed and dyed, Mr. Douglas reminded the Association that a year ago he had submitted figures from the Board of Trade export returns to show that, whilst the total export of cotton piece-goods exhibited a reduction against pre-war, the dyed proportion had suffered to a less extent than that of greys. Since then the Manchester Chamber of Commerce had issued a conversion table, by means of which the percentage increase or decrease of square, as compared with linear, yards was ascertainable.

Export of Dyed Goods

IF the figures quoted at that time were examined, viz., that the exports in the grey state for 1924 were 70·1 per cent. of the average of the four years 1910, 1911, 1912 and 1913, whereas the exports in the dyed state for 1924 were 70·5 per cent. on the same period, and were adjusted by the application of the Manchester Chamber of Commerce table, the exports of cotton piece-goods in the grey state in the year 1924 were found to represent 65·5 per cent. of the average of the pre-war years, whereas the exports of cotton piece-goods in the dyed state in the year 1924 represented 79·3 per cent. of the average of the pre-war years. The corresponding figures for 1925 were :—

	Million square yards.
Exports in the grey state	1,383
and in the dyed state	739
Being in the case of grey goods .. (of the average of the years 1910, 1911, 1912 and 1913), and	59·7 per cent.
In the case of dyed goods .. .. (on the same period).	76·8 per cent.

The obvious conclusion to be drawn from these figures, Mr. Douglas contended, was that the exports of cotton piece-goods in the grey state were not maintaining their position to the same degree as the dyed trade, so that the suggestion that dyeing prices were having a detrimental effect on the export trade in dyed piece-goods was not supported by the facts.

Mr. Douglas concluded his statements on dyeing charges by saying that, just as price-cutting was generally not done by those working on the lowest basis of cost, but by those who knew least about their costings, so in the case of critics of dyeing prices, it appeared that the less definite their knowledge the more vehement was their criticism. His case, however, would not have suffered had he allowed the figures to speak for themselves, for only by getting the facts from every point of view can a satisfactory view of the situation be formed; and the statements made in our articles last month certainly indicate that other no less important arguments have also to be taken into account.

Bleachers' Share Bonus

DESPITE the difficulties that are being experienced in certain sections of the dye trade, those engaged in the bleaching branch should have good reason to be satisfied with their position. It was announced this week that the board of the Bleachers' Association have decided to capitalise £1,422,651 out of the general reserve fund and distribute it among the shareholders in the form of a bonus This will be payable to shareholders registered on March 25 and will work out at the rate of three new shares for every five held, which is equal to 60 per cent. The new shares will rank for dividend as from April 1.

According to the balance-sheet made up to March 31, 1925, the Bleachers' Association held a general reserve of £1,850,000, in addition to a dividend equalisation reserve of £180,000, an investment contingencies fund of £50,000, and an undivided profit balance of £387,937. After the capitalisation now proposed, the company will still possess reserves and undivided profits of more than a million, without allowing for any additions that may be made to these funds from the profits of the year now closing.

To commemorate the completion of its first twenty-five years, the Association has just published an historical volume, some account of which is given in this issue.

British Dyestuffs and Scottish Dyes

UNDOUBTEDLY the event of most interest to the dyestuffs industry since the publication of our last supplement was the announcement which the board of the British Dyestuffs Corporation communicated to the Press on February 26. "British Dyestuffs Corporation, Ltd.," it stated, "has acquired a majority of the share capital of Scottish Dyes, Ltd., and these two companies have entered into an agreement under which the management of Scottish Dyes will remain as at present. Mr. James Morton will continue as chairman of the company, and Dr. J. Thomas as managing director. Professor Sir William J. Pope, K.B.E., F.R.S., who has acted for several years as technical adviser to Scottish Dyes, has been appointed a director of that company. The arrangement provides for concentration of the manufacture of vat dyestuffs at the works of Scottish Dyes, Ltd., at Grangemouth."

The increasing importance of vat dyestuffs to the British manufacturer of cotton textiles adds great interest to the arrangement now announced. In pre-war days vat colours were looked upon by the German dyestuff manufacturers as the crowning achievement of a successful scientific industry, and it must have been a great blow to their just pride to watch the rapid progress of British chemists as they successfully negotiated the difficulties of plant and technique. This progress has not only led to the manufacture of a very satisfactory range in this country, but has also been rewarded by the discovery of

Caledon Jade Green, undoubtedly the most commercially valuable vat colour placed on the market in recent years. There had been some misgiving as to the chances of survival of this phase of the British dyestuff industry when the full blast of German competition should be encountered, and it would be a tragedy if the unforeseen brilliance of British chemists were to be annulled by a lack of commercial foresight. While the arrangement has been the subject of considerable discussion as to the future of dyestuffs policy, there is no doubt that it should lead to the strengthening of the vat colour position and to more rapid expansion. It will be noticed that the arrangement provides "for concentration of manufacture," and it is therefore assumed that each firm will continue its present selling arrangements.

Dr. John Thomas, the new managing director of Scottish Dyes, has had a close connection with the dyestuffs industry since his appointment in 1918 as chief chemist to the then Solway Dyes Co., and it is a particular pleasure to be able to publish a brief sketch of his career in this issue, as the third contribution to the special series of dyestuffs biographies that we are publishing in this Supplement.

Artificial Silk

THE rapid growth of the artificial silk industry has undoubtedly been one of the most interesting developments of recent years, both from a scientific and industrial point of view, and the consequent stimulus to research in the technique of dyeing is not the least important of the results it has effected. How huge is this new industry was admirably brought out in the special artificial silk supplement published with *The Times* on Tuesday. The several prospectuses of new companies recently issued have reminded the public that large investments are being made in this new field; but it is perhaps not generally realised that in British concerns alone over thirty million pounds of capital is already invested. Despite this remarkable size, however, and the fact that the demand for the new material is at present greater than the supply, only one British company—leaving out of account a number of successful firms engaged in converting the raw material into semi-finished or finished goods—is as yet a dividend-paying concern, namely, Courtaulds. British Celanese, the second largest concern, and the successor of the British Cellulose Co., is now producing on an increasing scale after passing through many vicissitudes, but has not so far been able to reward its shareholders. Although the majority of the other concerns have only been formed in the last few months and a further period must elapse before some of them come in as sellers on the open market, it is certain that by the end of this year the potentialities for the production of artificial silk will be enormously increased.

Problems of Dyeing Technique

THE immediate adaption of dyeing methods to the peculiar properties of artificial silk has been no less phenomenal than the developments in its production. Indeed, such were the problems presented by the new material that without a corresponding advance in dyeing it is probable that it would never have been put to the innumerable uses which have created such a demand for it. The classes of dyestuffs used in the dyeing of artificial silk of the nitro-cellulose, cupra-ammonium and viscose varieties are the same as those which are used for cotton, but dyes giving acceptable results on cotton were often found to give poor effects on the new material. Acetate silk, on the other hand, has little or no affinity for many of the dyestuffs employed for cotton and other natural fibres, and this necessitated the introduction of an entirely new technique in dyeing. The many discoveries in this last direction and the remarkable success of the new processes constitute a lasting tribute to the efforts of British dyestuffs chemists and have dispelled the opinion too often held that this country did not compare favourably with its rivals in the outcome of original research.

The article by Mr. C. M. Whittaker, quoted elsewhere in this issue, shows clearly how the related factors—mechanical, chemical and physical—all have to be taken into account in the development of a new process, and that any one of these may necessitate quite unexpected modifications in some other part of the procedure.

Among the problems receiving attention at present is dyeing in the form of slubbing or fibro for the purpose of admixture with wool for brilliant mixture effects. Patents have also been taken out for dyeing the spinning mixture previous to spinning the yarn, and although practical objections have still to be overcome before this process can be adopted, these many problems are characteristic of the research in the field of dyeing that is being devoted to this interesting new material.

White Discharge Effects

AN example of the results of this extensive research now being conducted on artificial silk is the modified process for obtaining white discharge effects on the new material, a patent for which has been applied for by the British Dyestuffs Corporation. It was found that the reduction discharge processes based on sodium sulphoxylate in general use for the production of discharge effects on cotton, silk and woollen materials were not effective when applied to acetyl cellulose, but the obvious advantages of the discharge method in the production of patterns led to experimentation to discover a method of adapting it to the new fibre.

It has now been found that the addition of sulphocyanides to the reduction discharge printing paste containing sodium sulphoxylate brings about the reduction of many colours that hitherto have not been found dischargeable when dyed on acetyl cellulose, although theoretically such colours should be easily dischargeable. According to tests made by the B.D.C. the calcium sulphocyanide gives the best results. Various colours have been marketed to give white discharges with the new process, and the latest pattern sheet issued by the Corporation shows three beautiful specimens of acetyl cellulose dyed with 2 per cent. Celliityl Fast Golden Yellow, 2 per cent. Ionamine Red K.A. (direct shade), and 1·5 per cent. Acronol Brilliant Blue. If those colours are combined with dischargeable direct colours, it is also possible to obtain white effects on mixtures of cotton and acetyl cellulose.

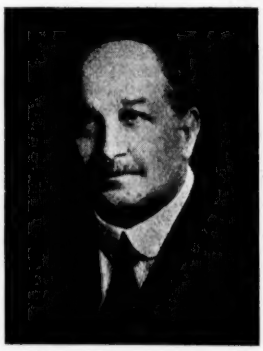
American Dyestuff Symposium

"THE accomplishments of the American chemist in the Dye Field" is shortly to be the subject of a symposium at Philadelphia, organised by the Dye Division of the American Chemical Society, on the occasion of the Society's Jubilee celebrations. The discussions should be of almost equal interest to this country, for the conditions in which the United States and Great Britain found themselves on the outbreak of war were very similar, and their exertions to make themselves independent of foreign dyestuff supplies for the future have followed nearly parallel courses. Both have made the same initial mistakes and both have gradually turned their early failures into comparative successes. The American Chemical Society is making an appeal to all American dyestuff firms to co-operate in the conference, and by making known their own experiences to present an accurate picture of what America has accomplished in the last decade. If British firms could be induced to do the same with some approach to real frankness, the result would be of great interest and value to our own industry.

The Story of the Bleaching Industry

Changes Wrought by Chemical Processes

To mark the completion of the first quarter of a century's work the Bleachers' Association, Ltd., has published a commemorative volume, "Concerning the Bleaching Industry," which traces the history of this ancient craft from its earliest days, and indicates the rapid development that followed the introduction of chemical processes. As befits an industry closely allied with the art of dyeing and the artistic employment of colour, the book is a beautiful piece of printing and binding, the decorative borders and initial letters in red and the clear old-faced type in black having almost the effect of some mediæval hand-worked missal. The book has been compiled by Sir Alan J. Sykes, chairman of the Association, with the assistance of members of the staff, and the interest of the text is enhanced by the reproduction of many portraits, early bleach works and bleaching devices, indentures, price lists, wages sheets, etc., which tell the story even better than any words could. In these one is taken back to the very cradle of the art. "When America," as the author states, "was still an English Colony, when the post-horn was heard throughout the countryside and the highwayman helped himself to what he fancied, a little band of pioneers laid the foundations of a great industry," and "commenced the difficult task of fashioning from crude farmhouse methods commercial processes which have stood the test of time."



SIR ALAN J. SYKES.

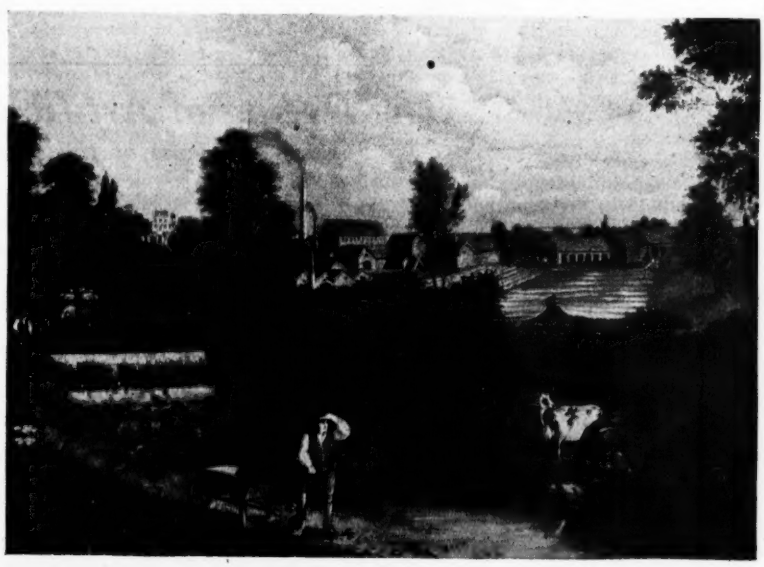
Lancashire, it is clear, was from the earliest times associated with the bleaching industry. As early as 1322, Crumpsall had four bleaching grounds, and two centuries later Lord de la Warre, whose ancestor Thomas had endowed the Collegiate Church of Manchester, owned "Walke" Mills, on the River Irk. The young cotton industry, however, had for some time to struggle hard against prejudice and the love of safeguarding existing interests. In 1700 the use of cotton was legally forbidden, in the interests of sheep farmers and woollen manufacturers, and this, with other restrictions, was only repealed by the Manchester Act of 1736, permitting cotton and linen mixed calicoes to be manufactured. The business of bleaching and finishing, too, was hedged about with many irksome restrictions. The use of lime was actually proscribed, and the prohibition continued in force until the beginning of the nineteenth century.

The early bleaching method consisted in alternate "bucking" and "whiting" or "crofting"; hence the term "whitster." "Bucking" was the process of boiling with lye prepared by lixiviation of the ashes of plants rich in alkali carbonates; "crofting" was the spreading of the cloth on the "crofts" (small enclosed grass fields) for its exposure to the sun's rays, a process still followed in certain valleys in the Vosges district of France and probably in other sequestered parts. It was on these homely lines that the industry continued until the middle of the eighteenth century, when the conditions were swiftly revolutionised by mechanical inventions and chemical discoveries. These inventions included Kay's flying shuttle, Hargreaves' spinning jenny, Arkwright's spinning frame, Crompton's mule, Watt's discovery of steam power, and Cartwright's power loom. All these mechanical devices enormously developed textile production, and about the same time came chemical processes which equally changed the bleaching and finishing processes.

The use of vitriol as a substitute for buttermilk, the earliest of the reagents employed, was proposed by Francis Home, who in 1756 published what is probably one of the first scientific works on bleaching. This proposal, along with that of Ferguson, who put forward a lime bleaching process, was at first treated with suspicion and disfavour, but the prejudice was presently overcome. In 1774, Scheele, the Swedish chemist, discovered chlorine, and noted that it possessed the property of destroying vegetable colouring matters. Berthollet, the Frenchman, immediately realised the possibilities of its use as a bleaching agent, and tried to get over the disadvantage of its penetrating odour by dissolving it in aqueous potash solution. This, however, proved by no means an ideal preparation for commercial use, and Charles Tennant, in 1799, took out his famous patent for bleaching powder, a previous patent for the production of bleaching liquor having been rendered invalid by the concerted action of the Lancashire bleachers.

Up to the time of Scheele's discovery, the recognised method of whitening cloth prepared from vegetable fibres was that of "crofting" or "grassing," and the substitution of chlorine for this slow and uncertain process in cotton and linen bleaching is the outstanding milestone in the history of the industry.

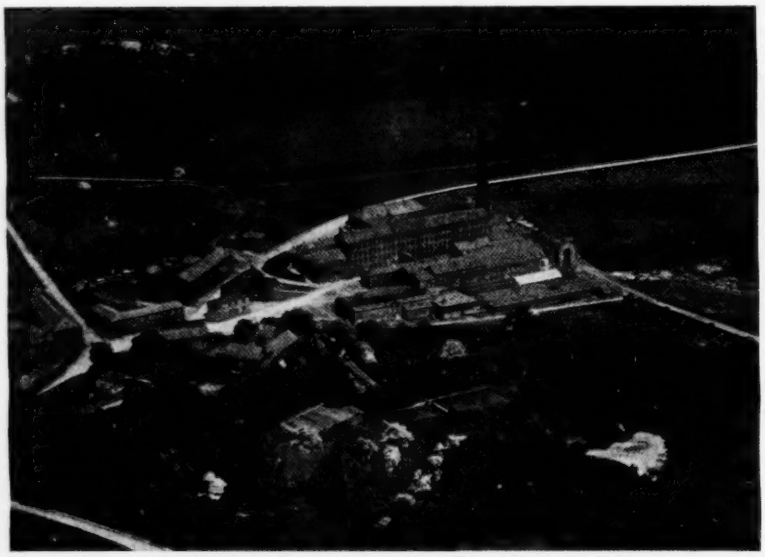
With the superseding of the "grassing" or "crofting" process came a change in the method of "bowking." It was noted that the addition of lime to the ash lyes used produced superior results in the boiling operation, this being due to the formation of caustic alkalis by the interaction of calcium hydroxide with alkali carbonates. Also pot-ash became replaced by the carbonate of soda prepared chemically by the Le Blanc and similar processes, designed to obviate the difficulties arising through insufficient supplies of plant ashes. The chemically prepared product was not used to any considerable extent, however, until the repeal of the Salt Duties in 1823, which made its production a more commercially feasible proposition. With the introduction of specific chemical reagents, bleachers began to turn their attention to the provision of materials for their own requirements. At most works where chlorine (then known as "oxygenated muriatic acid") was employed, means were provided for its manufacture, usually from salt, manganese, dioxide and vitriol, and from oxide of manganese and spirits of salts.



GRASS BLEACHING IN 1837 (G. & J. SLATER).

A licence to manufacture "oxygenated muriatic acid" and "oxymuriate of lime," probably by the former method, was granted to Slaters, of Dunscar, in 1815.

The services of the chemist were also utilised in the investigation of existing processes, and in the devising of new ones calculated to increase efficiency and cheapen production. Hence, the introduction of the ammonia-soda process for the production of soda ash, the electrolytic methods for the manufacture of caustic soda and chlorine gas, and the contact process for the making of sulphuric acid benefited the industry enormously. Chemical science also provided the bleacher with means for the standardisation of his materials and products, and for the detection, rectification, and minimisation of his faults. It has helped him to discard rule-of-thumb methods, to standardise his various operations, and to bring his art to such a state of perfection that he can repeat results with absolute certainty to the mutual benefit of the consumer and himself.



WORKS OF THOMAS RIDGWAY & CO., WALLSUCHES, HORWICH.

Concurrently with these changes, all tending to develop the industry on scientific lines, came a gradual revolution in the machinery installed to keep pace with large scale production, and the study of the new art of imparting chemical finishes to fabrics, of which the process associated with the name of John Mercer is perhaps the most notable example. And so what was originally one of the homeliest of crafts has developed into a national industry of a highly organised and complex character.

In the industrial conditions of to-day it is difficult to imagine the circumstances under which the early bleachers carried on their business. The protection of the exposed cloth against theft was one of their constant problems, and the penalties were of the most drastic character. Thus, we have a portrait of James Holland, an unattractive looking person, who in 1786 was actually executed on Bolton Moor for stealing thirty yards of cloth of the value of 2s. a yard. It was to safeguard the industry in such matters and to resist such restrictive measures as Pitt's Fustian Tax that the Society of Bleachers was first formed in 1781. Gradually this loose collection of business men began to exercise control over such matters as price lists, wages, and general conditions in the industry, and so the scattered operations of the individual members presently became co-ordinated, and standardised trade practices were built up. On June 7, 1900, the majority of the members of this older body joined together in forming the Bleachers' Association, Ltd. The businesses thus brought together numbered sixty, and since then twenty-five additional works have been purchased, eleven closed, and three sold. In the twenty-five years that have since passed, the Association has developed its activities until they embrace every ramification of the art of cloth finishing, and this first period of its career appropriately closes with the erection of the handsome new headquarters building in Manchester, known as Blackfriars House.

The Dyeing of Artificial Silk

Special Problems of the Process

How the old-established technique of dyeing has been successfully adapted to the most modern of fibres, artificial silk, is admirably described in an article in *The Times* by Mr. C. M. Whittaker, B.Sc.

For the purpose of dyeing, he writes, three of the four commercial varieties of artificial silk may be grouped together—nitro-cellulose, cupra-ammonium, and viscose, the fourth variety, cellulose acetate, having necessitated the development of a special dyeing technology. The classes of dyestuffs used in the dyeing of artificial silk of the first three varieties (with which this article exclusively deals) are the same as those used for cotton, but dyestuffs which give acceptable results on cotton will often be found to give poor results on artificial silks. Further, while cotton may be dyed in every stage of its manufacture—namely, raw stock, silver, cop, cheese, skein, warp, and piece, artificial silk is dyed in only two forms—skein and woven or knitted fabric.

Dyeing in the form of slubbing or fibro is being developed for the purpose of admixture with wool for brilliant mixture effects. Patents have also been taken out for dyeing the spinning mixture previous to spinning the yarn, but, though it is feasible, practical objections have prevented its adoption.

Dyeing in yarn form is carried out for "effect" threads which are subsequently woven as stripes in dress goods, blouse and shirting fabrics, and for colourings in damasks and furnishing fabrics generally, while all the artificial silk which is used for jumpers and embroidery purposes is dyed in yarn form. On the other hand, artificial silk satins, crepes, hosiery, knitted fabrics, pile fabrics, and many linings are dyed in the piece form.

It is frequently asked whether artificial silk may be dyed fast. The answer is that artificial silk may be dyed in all the varied fastnesses which are demanded by the purchasing public, as is evidenced by an examination of the guaranteed furnishing fabrics containing artificial silk which are displayed in the retail shops. Washing fabrics containing artificial silk are commonly sold under a guarantee of replacement should they fail to withstand the very severe treatment of modern laundry practice, while artificial silk linings fast to perspiration are in general supply.

Enamelled metal utensils will also be found quite satisfactory, though they have a definite limit in size, while their cost is usually high.

Mechanical Difficulties

The difficulties which arise in the dyeing of artificial silk yarn are entirely different from those which arise in the dyeing of cotton or linen, and may be grouped into two divisions, (1) mechanical and (2) physical and chemical. Artificial silk will not withstand the same mechanical handling that cotton will, either in the dry or, more particularly, in the wet state, and special precautions have therefore to be taken in the handling of the yarn during the dyeing process. The first process after dyeing is that of winding on to double-ended bobbins from which warp or weft is made as required. A well-

dyed skein will wind off within five minutes of an undyed skein. Experience has shown that in order to attain this end the time of dyeing should not exceed 45 minutes, coupled with careful handling. Unfortunately the necessary processing for the fastest dyestuffs—such as may be guaranteed fadeless or fast to laundry treatment—requires much longer than 45 minutes. It follows, therefore, that the higher the fastness of shade demanded the more will the winding of the yarn be depreciated. Owing to artificial silk losing strength when wet, it must not be submitted to any strain during the dyeing processes and therefore it may not be wrung out, as is commonly done with cotton. If yarn is stretched but not broken during dyeing, it will show as a bright thread in the fabric, this being due to the difference in the reflection of the light from the strained and from the normal thread surfaces. Artificial silk threads are made up of a large number of fine filaments, varying from 18 to 50 in a single thread; therefore, if the yarn is strained, a number of these filaments may snap, which causes the thread to become hairy and liable to become entangled with adjacent threads, thus causing trouble in the subsequent winding. Needless to say, such hairiness also considerably depreciates the appearance of the yarn, so that all rods upon which artificial silk is placed must be perfectly smooth. Steel tubes covered with hard rubber are commonly used, while Monel metal is now being increasingly adopted in Great Britain. It takes a fine, polished surface, while it has the advantage over copper in that it has not the same deleterious effect on the shade of many dyestuffs. In addition, it may be used for vat and sulphur dyestuffs, which may not be used in the presence of copper.

Machine Processes

In order to avoid mishandling of the yarn, machinery is being increasingly adopted. This machinery consists of two classes. In one class the dye liquor is circulated through the stationary yarn; in the other class the yarn is moved mechanically through the dye liquor. The first is quite successful with twist yarns, such as jumper cord, but it is not successful with fine yarns. In addition, this class of machine is usually built to accommodate large weights, whereas, owing to artificial silk being a fancy fabric, a large number of small weights in a wide range of shades have to be handled. The second may be used for any yarn, and may be built to handle small weights, so that it is to be preferred from the point of view of general utility. In this second type of machine the yarn is hung on porcelain rollers which are built in sections of 1–20 rollers as desired. The size of the roller permits of 3 lb. to 4 lb. being dyed on one roller, according to the class of material being dyed and the standard of work demanded. Each section may be raised or lowered into the dye liquor independently by hydraulic power. The rollers are so shaped that the yarn is given a throw in the dye liquor, ballooning the skeins so that the dye liquor may penetrate the individual threads. The rollers rotate for one minute in one direction, then automatically reverse, which minimises the possibility of the skeins becoming entangled. Each hank is completely rotated twice each minute. This machine was at one time only obtainable from Continental sources, but it is now being manufactured in England also.

Rate of Affinity

The chemical difficulties in the dyeing of artificial silk are due to the fact that its affinity for dyestuffs is so great that dyeing proceeds very rapidly. It follows, therefore, that unless the yarn is worked very rapidly unlevel results are very liable to be obtained. The dyer attempts to overcome this defect by using chemicals which have a restraining influence on the rate of absorption of the dyestuffs.

One of the physical difficulties is due to the fact that artificial silk when wet becomes more or less pulpy, and the threads cling together in a mass so that there is a great tendency for the outside of the yarn to be dyed a deeper shade than the inside of the yarn. This is due to the inability of the dye liquor to penetrate the threads massed together. Another difficulty is due to the fact that the rate of affinity of individual skeins for dyestuffs may vary. The result is that there may be found two or three tones of one colour in a bulk dyeing. Experiments have shown that these variations in commercial viscose may be considerably alleviated in many shades by a correct choice of dyestuffs.

The writer has devised a simple test by which the suitability of direct cotton dyestuffs for artificial silk may be determined—direct cotton dyestuffs are the dyestuffs which are used for dyeing 90 per cent. of the production of artificial silk. By this test it is possible to allocate a number to each individual direct cotton dyestuff. According to the figure so determined, it is possible to say whether it will cover or exaggerate the possible differences in commercial artificial silk and—what is often of more importance—whether it will give an even result when mixed with other dyestuffs.

The use of soft water is strongly to be recommended for artificial silk dyeing because soap is an ideal assistant—not only from the point of view of level dyeing, but also as a lubricant. It minimises friction between the individual threads as well as with the sides of the cistern, etc. In the knitting trade, a soft yarn which will slip over the needles is required. This desired softness is obtained by the use of soap in a soft water. Artificial silk may be dyed at the boil without detriment. Drying, on the other hand, should not be carried out at a higher temperature than 120 deg. F.

The Dyestuffs "Who's Who"

(3.)—Dr. John Thomas

Dr. John Thomas, Managing Director of Scottish Dyes, Ltd., was born in 1886 and educated at Barmouth County School, Aberystwyth University College, and Trinity College, Cambridge. Going up to Cambridge with an 1851 Research Scholarship, he afterwards gained a post-graduate research exhibition at Trinity and also took the Gordon Wigan Prize in Chemistry, which is a University award. His first appointment was in 1911 at the National Physical Laboratory, Teddington, as a research chemist for the Advisory Committee on Aeronautics. The next year he joined the Nobel's Explosives Co., Ltd., at their Ardeer Factory, where among other research he was engaged on the sensitive work of investigating explosives outside the accepted ranges of stability.

Dr. John Thomas.

His connection with the dyestuff industry began in 1918, when he was appointed chief chemist to the then Solway Dyes Co. On their reorganisation as Scottish Dyes in 1920, he was offered a directorship and in 1923 was appointed managing director. Under the recently announced arrangement with the British Dyestuffs Corporation, Dr. Thomas is to remain managing director of Scottish Dyes, and will be in charge of the greatly increased production which this alteration will mean.

He is a Fellow of the Institute of Chemistry, and in 1907 obtained the D.Sc. of the University of Wales for research work on explosives. He is also a member of the Joint Technical Committee of the Colour Users Association and the Association of British Chemical Manufacturers. Since his coming over to the dyestuffs side Dr. Thomas has probably had as great a share in the development of the British dyestuffs industry as any individual chemist, both in direct technical advances and in shouldering the burden of the dyestuff manufacturers.

Apart from his technical activities, Dr. Thomas plays a brilliant round of golf, and has a personality of singular charm.

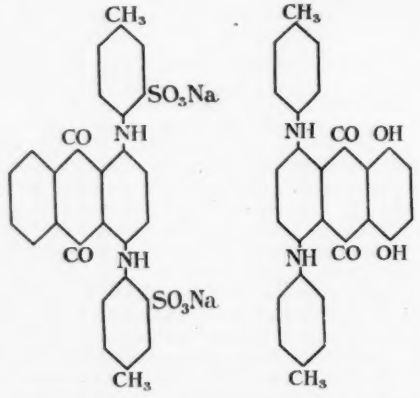
Dyes and their Application: Recent Technical Progress

By L. J. Hooley
(Scottish Dyes, Ltd., Grangemouth)

THE diazo reaction, which has been a most fertile method of synthesis to the dyestuff chemist, is restricted nowadays in the direction of faster products. In these a large number are produced on the fibre, insoluble substances being formed *in situ* which could not be taken up directly. For these the β-oxynaphthoic acid type of constituent is being used where possible. Products of this kind, but suitable for the colouring of oils and waxes, obtained with *p*-aminoazoxylenes as secondary constituents are described in U.S.P. 1,557,625 (Miller). Where azo dyes contain groups which can be used with mordants, a great increase in fastness, especially to washing and milling, is obtained. To avoid the disadvantages in operation and slightly deleterious action of the chrome on the fibre, products have been brought out during the last few years where the chromium is already in the dyestuff, which can thus be dyed with acid, although a higher concentration than is usual with acid dyeing is necessary. Orthohydroxy-azo derivatives appear to be specially suitable for chromium derivatives. A recent American patent, 1,529,995 (Fritzsche, Reber and Straub) couples these last-mentioned substances with 1-aryl-5-pyrazolones, where the aryl groups contain sulphamino groups. The coupled products are then treated with chromium hydroxide. In U.S.P. 1,551,073 (Straub), dyes containing chromium are used along with those which can be after-chromed, the two being combined before dyeing or dyed together, the chromium in the first apparently serving also for the second. The after-chrome colours mentioned are of the triaryl-methane series, the products being very fast to milling. Azo dyes for wool are described in B.P. 243,115 (B.D.C., Baddiley, Hill and Riley) by preparing anhydro bases from formaldehyde and primary amines and coupling these after diazotisation, with pyrazolones, naphthol sulphonic acids or naphthylamine sulphonic acids.

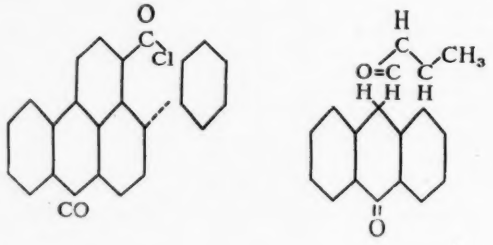
Production of Quinizarine

A new and interesting method of making quinizarine has been patented, B.P. 245,584 (United Alkali Co., Dodd and Sprent). The condensation of *p*-chlor phenol with phthalic acid in the presence of boric and sulphuric acids is known as one of the most satisfactory ways of making quinizarin. In the new method *p*-chlor phenol is replaced by *o*-chlor phenol and higher temperatures up to 240° C. are used. This is especially interesting as *o*-chlor phenol is obtained as a bye-product along with *p*-chlor phenol in the production of this latter by the direct chlorination of phenol. At lower temperatures hydroxy chlor derivatives may be obtained (B.P. 234,533, B.D.L., Thomas and Hooley). One of the principal uses of quinizarin is for the production of quinizarin green (Solway Green, etc.). A similar but substituted



derivative is described in B.P. 244,450 (M.L.B.), 5.8-dichlor quinizarine being used instead. Under the conditions employed it is, however, the chlorine and not the hydroxy groups which are replaced.

The new product may be expected to have a yellower shade than the old, to be more level dyeing and less fast to chrome. A new synthesis of the previously mentioned dibenzopyrenequinone, which is an orange vat dye, begins with nitrobenzanthrone, B.P. 220,304 (M.L.B.), the nitro group is converted to the carboxylic acid through the amine and the nitrile in the usual way. Then, after forming the acid chloride, this is condensed with benzene by



aluminium chloride, at the temperature of the water bath. By further treatment at 180° the aluminium chloride exerts a different action, causing ring closing to the final product.

A new method for the production of the isodibenzanthrone uses benzanthrone 1-(Bz) thioethers, instead of the usual chlor benzanthrone. As the thioethers are themselves obtained from the chlor body, a higher yield is possibly obtained this way. A new synthesis of methyl benzanthrone is from anthrone or similar anthraquinone derivatives with crotonaldehyde. The basis of the condensation may be seen by arranging the formulæ of the two substances together.

Kartaschoff continues his investigations into the theory of the dyeing of acetyl silk in *Helvetica Chimica Acta* (1926, IX, 152). The first portion of this was mentioned in these columns last month (February Dyestuffs Supplement, p. 16). In the case of the dyeing with suspensions of partially soluble substances a trial was carried out in which the dyestuff, anthraquinone-2-amino-1-methyl was placed in a filter paper immersed in the dyebath, so that only the solution came into contact with the silk. No dyeing took place, indicating that it is not a case of the dissolved dyestuff being absorbed and further dye then going into solution. Contact between the dyestuff and the fibre appears to be necessary. The theory of Langmuir is interesting in this connection, and offers a possible explanation. Other interesting points are dealt with, including the influence of carboxylic and sulphonic acid groups, the size of the molecule, and the partition of the dyestuff between the fibre and the solution.

Discharges on Cellulose Acetate

In B.P. 242,393 (B.C.A. and Ellis) secondary solubilising agents, consisting of sulpho-aromatic fatty acids are recommended, in addition to the substances already used for acetyl silk dyes. The method of the B.D.C. for obtaining discharges on cellulose acetate printed goods consists in using sulphocyanides along with the usual hydrosulphite discharging agents. The printing of acetyl silk is aided by the use of swelling agents, particularly thiocyanates and zinc salts, along with the dyestuff and gum in the printing paste. B.P. 244,143 (B.C.A. and Ellis).

Wool and silk have already been dyed by methods in which the dye is chemically combined with active groups of the fibre. Peacock has recently devised a method for cotton (*J. Soc. Dyers and Col.*, 1925, 42, 53), using the hydroxy groups of the cellulose as points of attachment. Ethers are formed with these by benzylating with m.nitro benzyl-phenyl dimethyl ammonium chloride, the nitro derivative of the familiar leucotrope, the nitro group is then reduced, diazotised and coupled with β-naphthol to give a rose colour, or with H acid to give a violet; the products, as may be expected, are fast to washing.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Yorkshire

Bradford, March 11, 1926.

IMPROVEMENT in the dyestuffs trade quietly anticipated at the commencement of the year is not yet in evidence. Woollen and worsted manufacturers of Huddersfield have not hesitated to express their disappointment, for they had expected a great improvement in their trade, although a slightly better condition towards the end of February brought into operation textile machinery that had been idle. Canada is still the only robust overseas customer for pieces, but South America is improving, and Bradford has been fortunate in securing large orders, formerly placed in America, for motor fabrics. At the annual general meeting of the Bradford Dyers' Association held in Bradford on February 26 the chairman, Mr. George Douglas, referred to criticisms made in regard to charges for dyeing in which it had been stated that dyeing prices were having a detrimental effect on the export trade in dyed piece-goods. He expressed disagreement with this, and showed by figures that the exports of cotton piece goods in the grey state were not maintaining their position to the same degree as the dyed trade.

The heavy woollen trade of Dewsbury remains depressed, but the rug trade shows improvement, particularly with South Africa and Canada. According to an announcement of the Board of Trade, Mr. H. C. Crawshaw, of Wormalds and Walker, Ltd., Dewsbury, has been appointed a member of the Dyestuffs Advisory Licensing Committee in place of Mr. Wadsworth, who has resigned.

There is nothing to report in the way of changes in prices. A steady demand prevails for solvent naphtha 90/160 at about 1s. 6d. per gallon delivered carriage paid. The most striking of the February company news is, of course, that concerning the share transaction between the British Dyestuffs Corporation, Ltd., and Scottish Dyes, Ltd.

Intimation that a company is being formed for the production of artificial wool, in a factory to be erected in this country, has aroused great interest, particularly in Yorkshire and Lancashire, where it is understood sites for the new structure have been examined. The new company will be a subsidiary of the Snia Viscosa, Turin, and will be known as the British Snia Viscosa, Ltd. As a preliminary a million shares of the parent company have been placed on the English market, and it is believed the new works will be in operation within twelve months from the formation of the company. A new private company, Hulse (Dyes), Ltd., has also been formed, with registered offices at Old Mill, Woodlesford, near Leeds, one of the directors being Mr. F. Hulse.

Lancashire

Manchester, March 11, 1926.

The slight improvement that set in towards the close of January has continued throughout the month, and on the whole the market has developed a more optimistic tone. The movement, however, is not so marked as to warrant any decided views on its permanency.

The cotton trade, on which the Lancashire dyestuff trade chiefly depends, remains in a very unsatisfactory condition, and the statement of Mr. Holroyd, at the annual meeting of the Master Spinners' Federation, that appalling losses are being sustained in the American cotton section of the trade, although perhaps unduly pessimistic, does call for special measures. Considering the cotton industry as a whole, the short time policy of the spinners is somewhat negative in character, and it is hoped that the suggestion of the special investigating committee, put forward by Manchester bank chairmen and supported by Lord Emmott and Dr. Rée, will eventually result in some agreed steps being taken with a view to the creation of a more constructive policy.

The colour lake trade and, to a lesser extent, the paper trade remain the bright spots in the colour-consuming industries. The enormous number of continental goods imported in 1925 explains the quietness of the felt hat trade in a good season, but it is not pleasant reading, particularly in view of the general prosperity of the retailers.

Following the fusion of the interests of British Dyestuffs Corporation and Scottish Dyes, Ltd., in the vat colour field, it is hoped that the manufacturing interests concerned will see the wisdom of passing on to the consumer a portion of the saving which should be effected. As vat colours are also manufactured by the British Alizarine Co. and L. B. Holliday and Co., however, their competition, together with the operation of the Dyestuffs Act, should be a guarantee against any attempt to increase charges.

Midlands

Leicester, March 11, 1926.

February has not been a very encouraging month for the dye manufacturer, prices for most dyestuffs being very nearly the same as those ruling a month ago. Small reductions have, however, been made in some cases.

It is now certain that hosiery shades for the summer will be a continuation of the delicate tints to which we have become accustomed, and manufacturers of artificial silk hose are now receiving orders for spring and summer goods. Wool spinners are working fairly good hours, and the local tanneries are rather more optimistic than was the case a month ago. Some hosiery dyers have issued further pattern cards illustrating three-colour effects on hose composed of cotton, celanese and wool, which can be produced from a single dyebath by careful selection of dyestuffs, separate dyes for each fibre which possess little or no affinity for the other two being essentially the only suitable colours for this work. Some dyers, however, prefer a two-bath method and claim it to be easier to dye to pattern with it than by a one-bath method.

Hose printing is a branch of the industry that may develop; fair quantities are being printed, but it cannot be denied that the inks now available possess undesirable properties. Ordinary paper printing machines are used with quickly drying inks that require no steaming, but this simple process does not give results comparable with those obtained by the elaborate methods used in textile printing in Lancashire and Yorkshire.

The educational side of the dyeing and textile industry is receiving more attention than ever before in the Midlands. The dyeing department of the University College at Nottingham was recently enlarged, whilst the chemistry and dyeing department at the Leicester College of Technology has grown during the past few years out of all recognition. This is all to the good, and it must be gratifying to those responsible for their direction to know that a considerable number of students from these institutions are doing very creditable work in the trade. The number of young foreman dyers is probably more than at any previous time, and taking into account the fact that a large proportion of the dyeing is either fancy work, or dyeing with colours of the vat class and consequently much more difficult than the plain straightforward dyeing of former days, this is all the more encouraging.

The Society of Dyers and Colourists and the recently added chemistry section of the Leicester Literary and Philosophical Society have held several lectures of interest to the trade, and the local branch of the Foreman Dyers' Guild now also have fortnightly lectures of great value to the dyer in dealing with the everyday problems and difficulties that confront him.

Scotland

March 11, 1926.

Conditions generally in all sections of the textile and dyeing trade show little change compared with the last two months, although February has been less broken than January. The activity at Hawick and in the woollen and tweed trade of the Border continues. Dyeing, however, is still quiet and orders will be welcomed. This applies equally to the Grangemouth, Glasgow and West of Scotland districts.

In the flax section a slight but general improvement has characterised February, but the linen trade remains as bad as ever, and the Scottish and Irish producers have combined in a request for an inquiry under the Safeguarding of Industries Act in an attempt to stop the decline that has now been taking place for several years. In the manufacturing and distributing sections the sales of dyestuffs remain steady at about their previous levels.

The United Turkey Red Co. made up their dividends to 10 per cent. by a final dividend of 7 per cent. J. and P. Coats, Paisley, have already paid their usual quarterly dividend of 9d.

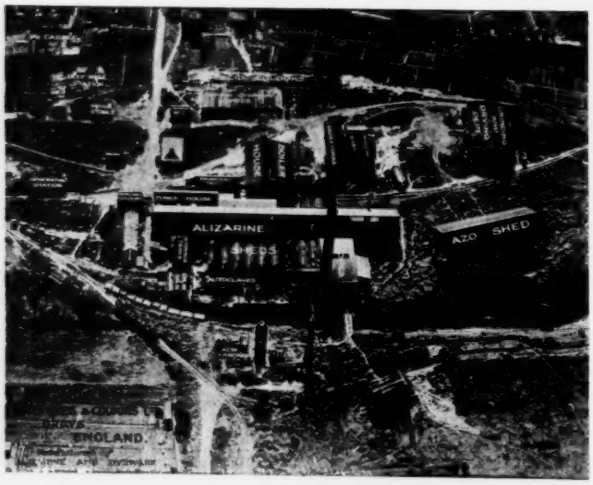
The most interesting news as regards Scotland is, however, the recently published announcement of the arrangement between Scottish Dyes, Ltd., and the British Dyestuffs Corporation. As in addition to their own production Scottish Dyes are to take over the vat dye section of the Corporation, a very considerable increase in output will result, which should give a further impetus to the rising prosperity of Grangemouth. The Scottish Dyes' works at Grangemouth have only been built during the last half-dozen years, and the original intention was that these should also take over the production of the Carlisle branch. Developments have, however, taken place so rapidly that they have been fully engaged without any decrease in the plant at Carlisle. In order to cope with the increased production important extensions will therefore be necessary, and this concentration of the production of the vat dyestuffs largely in the hands of one company should have consequent advantages of bulk production.

Around the Works

(3.)—Grays Dyes and Colours, Ltd.

GRAYS DYES AND COLOURS, LTD., was founded during the war for the purpose of manufacturing nitric acid for the Government, and ultimately the output of this product amounted to over 50 tons per week. At the end of the war considerable research in pigment colours was undertaken by the company as then constituted, but it was later decided to sell the existing interests, the ultimate purchasers being Mr. J. H. Deacon and Mr. J. A. Brooks. The conversion of the works into a plant suitable for producing dyestuffs of the anthraquinone series was then undertaken, and the capital of the company was increased from £20,000 to £60,000. The efforts of two years' further special research were eventually rewarded, and anthraquinone of high grade quality was produced for the production of alizarine reds of various shades.

The company's works are situated in Essex and are laid out so as to be self-contained, every process in manufacture



AIR PHOTOGRAPH OF WORKS AT GRAYS.

from crude materials being carried out. Twenty-five stages are carried out in the works during the manufacture of alizarine starting from crude anthracene, and the plant is supplied with its own water from wells on the site, the electricity needed being generated also at the works. Following the conversion of the plant from nitric acid to dyestuffs manufacture, the company continued to make this material for some while, but this has been discontinued.

Considerable business is done in by-products, especially in nigrosine and chrome alum, which are largely supplied to the leather trade, and the company does an extensive export trade. The works have exceptionally good transport facilities, as they are built on a site adjoining the river and thus command a private jetty and quayside. The works are also served by a special siding from the London, Midland and Scottish railway.

Those responsible for the direction of the company had throughout this early work been convinced of the important future for anthraquinone dyestuffs of the vat type, and considered that hitherto only the fringe of the research on these particular dyestuffs had been undertaken. Progress would have been greater but for the abnormal depression experienced by dye-using interests, coupled with the uncertainty that for a long time existed as to whether it would be possible to put the finished product on the market, owing to the methods adopted by certain continental business interests.

Economies in the Dyehouse

Address by B.D.A. Director

IN the course of an address on "Dyehouse Economics," delivered at Bedford before the Society of Dyers and Colourists, Mr. T. D. Buttercase, director of the Bradford Dyers' Association, said the problem of the elimination of waste had apparently received full attention in the United States. Would an investigator in this country report equally favourably? Mr. Buttercase was unhesitatingly in favour of payment by results, and remarked that the wages' agreements covering the allied trades of bleaching, dyeing, printing, and finishing worked well, and compared favourably with those in any other industry which was comparable from the point of view of the physical effort and skill required. In the main, where payment by results had been instituted, restriction of output had largely disappeared.

There was enormous waste in the dyeing industry because of lack of scientific system in selecting operatives best suited for particular jobs. There was room in most dyehouses for saving in the actual use of colours and chemicals, as could be shown by an attempt to reconcile the totals represented by the dyers' statements with actual consumption according to purchases adjusted by stocks. He had known careful checking in this respect, in the case of chemicals, to effect a reduction of a discrepancy of 15 per cent. to one of less than 5 per cent. in a few months.

Assuming that it could be shown that all avoidable waste had been eliminated in the dyeing industry, there remained the paramount point of what price the dyer could command. The establishment of price-fixing associations had had one marked effect—namely, the higher quality of the work turned out. Competition for orders remained as keen as before, but its basis should be quality and service rather than price, and that was of greater benefit to the consumer than low prices, which must be obtained largely at the expense of operatives.

"I venture to predict," said Mr. Buttercase, "that in the not far-distant future, if the dyeing trade as a whole is to continue to progress, further developments of price-fixing will be necessitated, and the only permanent and sound edifice I can visualise is one built on a uniform system for the calculation of costings for the industry as a whole."

Limitation of Profits

A great deal had been said about alleged excessive profits in the dyeing trade. The dyeing trade might well insist on the production of figures by their critics showing their own returns on capital employed over a period of years. It would be well for the industry to have ready its own scheme for the limitation of profits. All recent tendencies indicated that we were on the way to some system of control of profits, but no one seems yet bold enough to bring forward a workable scheme.

Slipshod costings, said Mr. Buttercase, were often less reliable than good guesswork, and unless they were prepared to go into it thoroughly they had much better leave it alone. The main functions of any sound system of costings should be the elimination of waste, to throw light on past experience and to act as a guide for the future; for the comparison of different methods of treatment and to demonstrate the margin of profit or loss on each line; the furnishing of statistics with a view to co-ordinating the activities of those respsonsible for the cost of the various factors of production; to form a basis for the scientific fixing of prices, paying particular regard to the incidence of standing charges during slack and busy periods.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions on current problems will be welcomed*

A New Start

WITH the granting by Mr. Justice Eve of the application for the reconstruction of the capital of the British Dyestuffs Corporation, that great organisation is at last free to make a fresh start. Its capital has come down to reasonable proportions, its management is freed from Government control, its directorate is in the hands of men scientifically and commercially qualified for the work, the recent agreement with Scottish Dyes, Ltd., promises to strengthen the operations of both companies, and the general directorship could not be in safer hands than in those of Dr. E. F. Armstrong. The Corporation has had a difficult career. It was formed in a hurry, when the country and especially the textile industry realised the danger of trusting to foreign sources for the necessaries of national trade and even national existence. Every class at that time, traditional Free Traders no less than others, declared that at any cost the great textile trade must have behind it a national dyestuffs industry sufficient for its needs. The Government were equally sensible of the need from quite another side—the close relation between dyestuffs manufacture and the production at need of high explosive. Further, it was urged that we must have an efficient school of organic chemistry, and that the necessary research chemists and technologists could not be secured without an industry in which they could find employment. So, in high hopes, with the cordial blessing of the Government, the country, and the textile industry, the Corporation was formed to supply the nation with what we had trusted Germany in the main to provide for us before.

A Difficult Career

THE Corporation, as we have said, has had a difficult career, and at times it almost seemed doubtful whether it would pull through. It made at the beginning just the mistakes one might expect in an enterprise established in a hurry and desperately anxious to do more, as we now see, than it was possible for any new organisation to do at once. Its products were criticised and—quite unreasonably at the time—their quality, especially as regards fastness, was unfavourably compared with the old German standards. Then differences crept into the management. There was lack of unity and agreement. There were reports that the directors were at loggerheads. It seemed clear that something was seriously wrong. The first turning point came with the acceptance by Sir William Alexander of the post of managing director. It was not the pleasantest of jobs that he undertook. It required courage and perhaps a touch of ruthlessness to clear the situation up, regardless of inevitable criticism. Nevertheless, it was done. Sir William Alexander had an onerous and unpleasant duty, and he discharged it fearlessly. What he did then was necessary for the later developments; he cleared the way. And having done what he set out to do, he withdrew to allow others to carry the work forward. The advent of Dr. Armstrong soon after seemed almost providential. His qualifications both in chemistry and in large scale organisation were instantly recognised. Within a few months the situation began to change visibly for the better under his direction. He has got a real directorate together, and he has the complete confidence of his staff and the goodwill of the public. We believe the Corporation has passed through its most difficult days, and can now, with some confidence, look forward to steady progress.

The Government Shares

IT was to be expected that the surrender by the Government of its shares at a much reduced figure was an opportunity not to be missed by Parliamentary critics. It has been triumphantly brought out that the reconstruction scheme involves the Government in a capital loss of over a million pounds! The mistake the critics make is in regarding the Government subsidy as an ordinary investment, made with the principal object of securing a decent rate of interest. It was, on the contrary, urgent expenditure undertaken in the national interest. It was as much expenditure of this class as the vast sums spent on naval and military expansion, and as the heavy expenditure still undertaken for these purposes. The Government receives no interest for its expenditure on education, scientific research, and scores of other classes of work it undertakes, because it is all necessary for national existence. If anyone could have assured the Government and the country that by the grant of a solitary million our production of essential dyestuffs for home use would be changed from the proportion of 20 per cent. to 80 per cent. within a few years, the bargain would have been welcomed as dirt cheap. And so the bargain has actually worked out. All the credit, it is true, for our changed position to-day must not be attributed to the Corporation. Numbers of other firms have taken an honourable part. But the Corporation was after all the big thing to which the country looked, and at last, there is good ground to believe, the country will not look to it in vain.

The Chemical Society's Visit

WE are confirmed in this view by what we have heard from members of the Chemical Society who, during the recent visit to Manchester, inspected the Corporation's research laboratories, dyehouse department, and experimental plant at Blackley, the headquarters of the old Levinstein works. The efficiency of the research organisation was not the only point that impressed the visitors. We believe it to be the case that substantial economies have lately been effected in general organisation without the smallest loss of efficiency, and that, in spite of the lowered activity in the textile industry, output and sales are increasing. But so much has been said about research of late—and quite properly so—that a few facts may not be amiss. The Corporation at present employs 125 chemists, of whom 83 per cent. hold high university degrees. Every university in England, Scotland, Ireland, and Wales is represented in what is described as "this deliberately chosen, judiciously sorted, and carefully fostered body." The chemical staff are employed in five fundamental directions—the management of works, the manufacture of products, research, the accurate and painstaking work connected with the analysis and standardisation of products, and the technical service of customers. Every works manager is a highly trained university graduate. Every manufacturing department is not only staffed with chemists, but is under the immediate control of a chemist. All research work, whatever its character, is controlled and carried out by chemists. In fact, the entire work of the

Corporation is in the hands of chemists, from the managing director downwards. It is a record in which some pride may reasonably be taken.

I.G. Competition

ATTENTION may be drawn to the important statement in our market report that the I.G. Farbenindustrie propose to set up a registered limited company in this country with head offices at Manchester for the purpose of competing for a greater share of the trade of this country than has been recently enjoyed. It is clear from this that the German interests are not prepared to surrender British custom without a struggle, but with the Dyestuffs Act in operation and with the British industry steadily improving in organisation their task may not be so easy as in former days. For the moment, however, we must await developments. The matter is dealt with at greater length in THE CHEMICAL AGE editorial notes.

Methylene Blue as a Reagent

THE manifold possible uses of standard methylene blue hydrochloride solution as a laboratory reagent for use in analytical chemistry has not been generally realised. The subject was discussed a short time ago by Dr. F. W. Atack, in a paper on "The Use of Dyestuffs in Analytical Chemistry," published in *Canadian Chemistry and Metallurgy*. In this paper it is pointed out that the use of methylene blue depends on a number of factors, among others its capacity to form insoluble salts of definite composition (for example, the perchlorate); its reduction by certain reducing agents (stannous and titanous salts, etc.); and the oxidation of "leuco" methylene blue by means of oxidising agents (chromates, ferric salts, etc.). In addition to the usual method of standardisation of the solution (against ferrous ammonium sulphate via titanous chloride) it may also be standardised against potassium chlorate or perchlorate (the latter method avoiding the use of titanous chloride), and otherwise. Standard methylene blue hydrochloride solution may be used in the determination of hydrosulphites, titanium, molybdenum, stannous chloride and tin, chlorate, chromium, iron, vanadium, perchlorate in presence of chlorate, potassium, dissolved oxygen in water and alcohol, nitroso compounds, quinones, azo compounds, 1 : 2-diketones, etc. This formidable list cannot be equalled in variety of application by any known standard solution in common use as a volumetric reagent. The necessary methylene blue hydrochloride is a commercial product, and the standard (N/40) solution necessary can be prepared at less than half the cost of decinormal permanganate solution. Dr. Atack's paper concludes with a very useful bibliography.

Dyeing with Coal Tar Dyestuffs

THE production of a second edition of "Dyeing with Coal Tar Dyestuffs," by C. M. Whittaker (London: Baillière, Tindall and Cox, pp. 248, 10s. 6d.), has necessitated a number of additions. The great attention which has been paid recently to artificial silk is reflected in the new section devoted exclusively to the dyeing of this class of goods. Among other advances noticed are the introduction of the solubilised vat dyestuffs, the expansion of the range of shades possible with azoic dyestuffs, and the use of katanols instead of tannic acid for the mordanting of vegetable dyestuffs. The book is divided into fourteen sections, commencing with a general survey of dyeing. Then follow sections dealing in detail with the use of the various classes of dyestuffs—basic, acid, alizarine, etc., direct cotton, azoic, resorcin, sulphur and vat dyestuffs. Finally, the author deals with the dyeing of union fabrics, colours produced on the fibre by the oxidation of coal tar products, other uses of coal tar dyestuffs, the dyeing of artificial silk, and the valuation and detection of dyestuffs.

"This book," states the author, "is written with a view to giving the reader a firm grasp of the chemical principles involved, and the methods used in the application of the coal tar dyestuffs, so that when he commences carrying out dyeing under actual commercial conditions he will know the why and the wherefore of the methods employed." The writer's long experience is reflected in the practical manner in which the subject is treated.

B.D.C. Announcements

THE British Dyestuffs Corporation announce the following revised prices in their new fine chemical price list: *a*-naphthylamine, 15s. per lb., 1s. 3d. per oz.; Indigo carmine, 3s. 6d. per oz., 1s. 4d. per 10 gms., 10d. per 5 gms. Their new products include Acid Navy An, a colour of particular interest as a level dyeing fast-to-light navy blue, suitable for dyeing woollen and worsted piece goods. Owing to its very good solubility it is strongly recommended for machine dyeing.

Forthcoming Dyestuff Books

We learn from Ernest Benn, Ltd., that two new books of considerable interest to the dyeing community have been arranged for. One, by Mr. A. J. Hall, deals with *Dyeing, Bleaching and Finishing Machinery* out of the author's full and varied experience of that side of the industry. The text of the book has been completed, and the work is shortly expected to be out of the press. The other is a companion volume to the recently issued *Dictionary of Chemical Terms*, namely, a *Dictionary of Intermediates*, which is to be produced under the editorship of Mr. D. Ivor James. Mr. James, who was for some time on the chemical staff of the Gas Light and Coke Co., and did valuable research work during the war, is an admitted authority on intermediates, as well indeed as on organic chemistry generally. Chemistry, however, is not his only interest. He took orders in the Church first, later qualified for the Bar, and now, after some years of experience in the chemical industry, has settled down as Vicar of Woodlesford, Yorkshire. In this retreat he still pursues his literary and scientific studies.

The Fade-Ometer

AN interesting brochure, "More About Colours, Fast or Fugitive?", describing the Fade-Ometer, has been issued by Kelvin, Bottomley and Baird, Ltd., of 51-52, Fenchurch Street, London, E.C.3. The Fade-Ometer is an instrument which has been specially devised to provide a definite standard of fastness to light of colouring materials. These materials are exposed to the light of a violet carbon arc, which provides a close approximation to the violet end of the spectrum. Tests which normally require exposure to sunlight and which normally may be very long (besides suffering from complications due to change in intensity of outdoor light with season, weather, etc.) may be carried out much more quickly by the use of the Fade-Ometer, which moreover provides light which is perfectly reproducible, hence giving an absolute standard. The instrument has forty exposure openings, thus allowing of forty identical tests at one time, and is provided with a humidifier, which maintains the proper humidity in the region of the samples. It may be run on alternating or direct current. The Fade-Ometer finds application with dyestuff manufacturers, rubber works, textile mills, clothing and garment manufacturers, in the examination of printing and other inks, paints and varnishes, etc., and is being largely adopted. Copies of the brochure may be obtained on application.

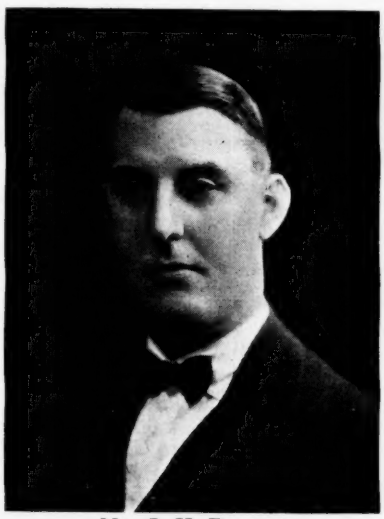
An Adventure in Dyemaking

By J. H. Deacon

In the following article Mr. J. H. Deacon, of Grays Dyes and Colours, Ltd., gives an account of the successful manner in which he and those associated with him founded and developed a dyestuffs manufacturing business. The enterprise is typical of many entered upon during and since the war.

At the close of the war, one's mind turned to matters commercial, and in reviewing the world position of industry, chemistry and the manufacture of dyestuffs held out great possibilities. England had made a great success of heavy chemicals, and I saw no reason why we Britishers should not be successful in dye manufacturing. Some companies had already made great strides under enormous difficulties, which, owing to the thorough and painstaking propaganda on the part of Germany, had been regarded by many as insurmountable.

Having finally decided that the dye industry held out great hopes it remained to be settled what class of dyestuffs would be in greatest demand. Taking a careful review of the situation, I found that the vat colours would probably be of ever-increasing importance. One felt reasonably secure in tackling the problem, as the Government had given the lead by taking a considerable financial interest in the industry, and what was



Mr. J. H. Deacon

of great consequence was the promise of a Government Bill to safeguard the new industry for a period of years, to enable the manufacturers to erect plant and carry out research, so that when the goal was reached they would be able to stand on their merits and face world competition. What actually happened in this connection would take too long to re-state; suffice it to say that many disappointments and broken promises were experienced. With plenty of energy and ambition, together with a moderate amount of finance, a factory was secured at Grays for the purpose of carrying on research and ultimately erecting plant to manufacture some of the dyestuffs of the anthraquinone series.

The complexity of the problem will be appreciated by the chemist. It was gratifying, however, to find, while the research work was proceeding that British chemists were quite the equal of any I had met in Germany. All my problems were solved by British chemists and engineers, and the work embraced processes for the purification of anthracene, and the preparation of anthraquinone, beta chloranthraquinone, 1·5 dinitroanthraquinone, beta aminoanthraquinone, alizarine and several derivatives of this colour.

Experiments had to be carried out on electrical catalytic oxidation, sulphonation in the presence of catalysts, and the possibilities of turning the by-products into saleable commodities. This latter problem is all-important. Its value will be readily appreciated when one realises the valuable products that exist in crude carbazole which is obtained in the purification of anthracene. Crude carbazole contains acridine, phenanthrene, pyrene, chrysene and many other higher hydrocarbons; it has also possibilities in the preparation of synthetic gums and carbon black, is used for pickling telegraph poles, and is an insecticide against Phylloxera. To deal successfully and profitably with crude carbazole would occupy the time of many chemists and process workers. It is problems such as these that take years and much labour to solve, and when judging the progress of the dye industry it is positively amazing to see what has already been accomplished.

I was impressed in the early days with the possibility of effecting the oxidation of anthracene to anthraquinone by an electrical process in the presence of catalysts. I directed a lengthy research to exhausting the possibilities, using cerium, chromium and didymium as catalysts with and without nitric acid and mercury salts. The results were only moderate, not more than 88 per cent. yields being obtained. Attempts to push the oxidation to obtain a 100 per cent. yield only resulted in secondary reactions and decomposition of the anthraquinone. Other rare metals were tried, notably vanadium, in a wide range of salts, but no improvement was observed. Work in this direction is still being actively pursued, to examine the action of a still wider range of possible catalytic agents.

Another fascinating problem is the preparation of anthraquinone derivatives, which form, after all, the direction in which new developments in vat dye discoveries may be made. We have in hand an extensive programme for the direct synthesis of anthraquinone and its derivatives from benzoyl benzoic acid, phthalic acid, and its substitution products. So far the results are encouraging but not profitable. The prevention of the formation of anthraquinone disulphonic acid and increase of the yield of the mono-sulphonic acid has been the subject of experiments, using such inorganic catalysts as molybdic acid, and cerium and zirconium salts, and organic catalysts such as orthonitrophenol, orthobrombenzoic acid, etc. The results in some cases are promising, but extreme care has to be taken to prevent the formation of anticatalysts and catalytic poisons.

This and other research shows the efforts the dyestuff manufacturer is making in order to improve his products and cheapen them, and to learn more of the secrets with which Nature has surrounded the production of everyday necessities. My own company is considered a moderate independent undertaking, and I can assure my readers that given fair conditions we shall assist in the establishment of an industry that will be a credit to the country as well as a national asset. What is wanted is the sympathetic understanding and co-operation of the consumer. During its babyhood the industry is growing healthy limbs to support it in its manhood, and patience and the long view are required to see what manner of man it will become.

Laundry Chemistry

Laundry Chemistry, by A. Harvey (London: Crosby Lockwood and Son, pp. 116, 4s.) has the purpose of stimulating "among laundrymen the scientific study of the trade." After a short outline of the elements of chemistry, the author discusses water (its hardness and softening, etc.), oils and fats, soaps, chlorine bleaching agents, peroxides, sulphur bleaches, blues and blueing, starches, textile fibres, and stain removal. The use of chemicals of various kinds enters into every phase of the laundry industry, and these offer many pitfalls to the unwary. For example, the use of unnecessarily large quantities of various materials may easily involve the ruin of fabrics, while at the same time raising the costs. In the interests of both the laundryman and the general public it is therefore necessary that workers in this industry should give up rule-of-thumb methods and acquire some knowledge of the nature and properties of the materials used. This volume is written so as to appeal to the practical laundryman and to schools where laundry work is taught, and the author has succeeded in compressing much useful information into small compass.

The Ventilation of the Dyehouse

Fog Difficulties and their Treatment

The problem of keeping the dyehouse free from moisture and fog is discussed by Mr. A. S. Capwell, of the Canadian Blower and Forge Co., in the current issue of the "Canadian Colorist," and is illustrated by a series of photographs, of which three are reproduced.

In recent years, Mr. Capwell writes, improvements in methods of dyeing have involved the need for adjustment of ventilating systems. In not a few instances difficulties in obtaining a properly finished piece of cloth have been encountered owing to lack of proper ventilation and the presence of excessive moisture. In the past, problems of this kind have been looked upon as necessary evils and tolerated accordingly. The most troublesome factor is the damage done to the finer yarns of cotton and flax by water dripping from the ceiling and staining the articles, thereby depreciating the value of the finished product. With the excessive humidity and generally high temperature, dyehouse and bleaching operatives have uncomfortable enough conditions without being exposed to the danger and discomfort of foggy rooms, and roofs from which a continuous rain is falling. From both the hygienic and the economic point of view, correct air conditioning promises greater industrial health and greater personal efficiency. In some instances it has been actually impossible to work in the rooms because of the dense fog and rapidly floating vapours. It is in rectifying cases of this kind that the modern ventilating engineer can lay claim to some measure of success.

Engineering Problems

There are two major problems confronting the engineer in undertaking the ventilating of a dyehouse or bleachery:

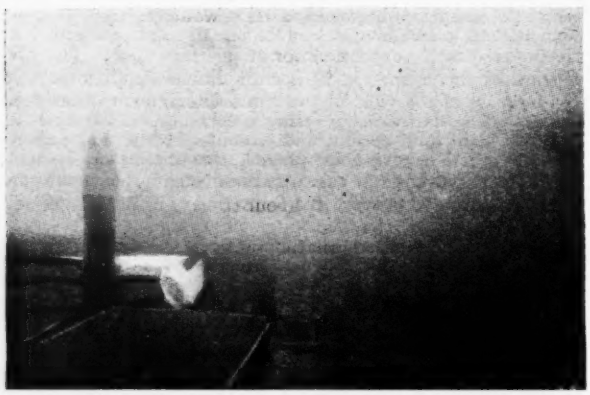


FIG. 1.—A DYEHOUSE FILLED WITH FOG OWING TO LACK OF VENTILATION.

first, the removal of large volumes of steam and water vapour given off by the vats, tubs, etc.; second, to facilitate its removal in such manner that the moisture will not condense on the cool interior surfaces of the building, thereby causing dripping on the textiles and rapid depreciation of the building as well. In more ways than one the ventilating requirements for each dyehouse constitute an individual problem to which no general rules or specifications can be applied. On the other hand, some basic principles are always applicable, although the details may vary considerably in actual practice. The first step, for instance, in the solution of any dyehouse ventilating problem is to determine the volume of air necessary to produce the required air change. Just what this will be will depend almost entirely upon the location and number of machines in the room, the greater the number the more frequent being the air change required. In installing any ventilating apparatus it is of some importance, if proper efficiency is to be attained, that the natural draught tendencies in the building be followed in both bringing in and taking the air from the dyehouse. If this is not followed, not only will a lower air capacity result, but the conflicting air currents will cause condensation. More important than this phase, however, is a study of the duct system to be installed. Upon the correctness of this layout, more than anything else, depends the proper functioning of the ventilating system. Provision must be made for passing dry warm air over each machine from which vapour and mist are coming and to form an insulator of warm air over the cold surfaces of the building,

FIG. 2.—A LATER VIEW, SHOWING THE EFFECTS OF VENTILATION.

such as the roof, on which condensation tends to settle. In this connection it is worth noting that in some plants a double roof has been built and warm air passed between the inner and outer sections. In other instances this sectional opening between the roofs has been insulated.

At the same time all natural air currents must be observed. Where there is a strong natural up-draught, for instance, such as over a tub or vat, this condition should be utilised and the exhaust located directly above if possible. In addition to the above factors governing successful installation of ventilating apparatus, there must be considered such points as the amount of work handled by each machine, location of runways where trucking is done, location of all roof timbers, type of construction of the roof and walls of the building, etc. In other words, it must always be borne in mind that no dyehouse problem can be solved successfully without first having an

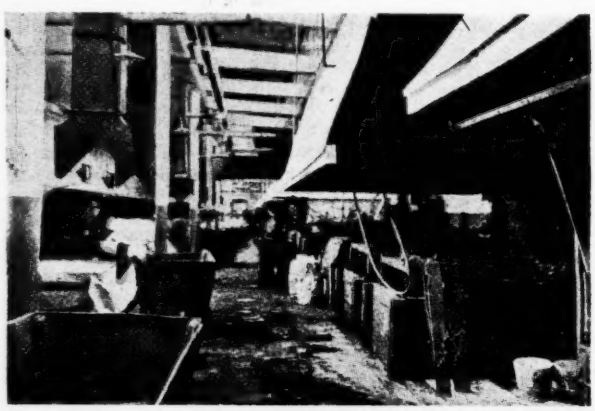


FIG. 3.—THE LAST STAGE: THE DYEHOUSE COMPLETELY CLEAR OF FOG.

intimate knowledge of all conditions as they exist, and these can be obtained only by making a first hand study of each case as it arises.

The principal parts of the dyehouse and bleachery ventilat-

ing apparatus are the heating equipment, the low-pressure multiblade fan in front of the heater unit, the warm air distributing ducts, and possibly some low-pressure exhaust fans or disc fans. The highly saturated air passes upward and through the roof of the building by means of ventilators or is exhausted outside by the disc or centrifugal exhaust fan. The fresh warm air always coming in creates a natural flow which forces the moisture-laden air outside. In the case of other floors being built on top of the dyeroom, it is then necessary to exhaust the air through openings in the wall, but this method is noticeably less satisfactory than the former.

Two American Examples

In New England and in a few of the other Eastern States —these sections constituting for the United States what the Manchester and Birmingham districts represent for England —are to be found the most striking examples of mechanically ventilated dyehouses and bleaching plants. To consider two of the most notable, mention can be made of the Sanford Mills, at Sanford, Maine, and those of the Firth and Foster Co. at Philadelphia. The first mentioned of these dyehouses, the Sanford Mills, presents several unusual features from the ventilating engineering standpoint, and aptly illustrates the point made earlier that each case must be considered at first hand and recommendations made accordingly.

This dyehouse is of reinforced concrete construction throughout, one storey high, and consists of two bays each 38 ft. wide, 108 ft. long and 16 ft. high. The dye tubs are arranged along the sides and set over ditches. The roof pitches towards the centre of each bay and is carried by concrete girders 20 in. wide and 40 in. deep on 11 ft. centres. These form pockets in the roof and make it necessary to use a special duct construction to prevent roof condensation. The concrete construction in itself is a serious setback from the ventilating engineering standpoint owing to the increased liability of roof condensation.

The total cubical contents of both bays is approximately 140,000 cu. ft. Because of the low head room, the large floor area covered by the machines and the concrete construction of the building equipment was installed providing for a two-minute air change. To accomplish this, the ventilating apparatus must handle 70,000 a.p.m. It consists of a No. 15 Niagara Conoidal fan and pipe coil heaters for warming the air before it passes into the ducts at a temperature of 100° F.

The layout of this mill provides for two rows of dye tubs in each bay, each tub so situated as to be directly under the space between the roof girders. In order to lead away the fumes and mist arising from these tubs it is necessary to run a duct between each set of girders and to blow both ways from the centre of each bay towards the dye tubs at each side. In this way the air is caused to flow across the dye tubs, thereby dissipating the steam and water vapour given off, and at the same time a continuous flow of this moisture-laden air is promoted outside without its coming into contact with any cool surfaces which would tend to make the moisture condense.

Importance of Air Exits

For the air exhaust no fans are provided. It is customary to make provision for positive exhaust by means of fans, only when the natural up-draught is insufficient to lead the saturated air away. In connection with this point it must be remembered, however, that it is just as important to provide for the exit of the air as to provide for the entrance. This is a point often lost sight of. At the Sanford Mills roof ventilators are provided to take care of the exhaust and are so designed as not only to do away with the need of the exhaust fans, but also to prevent any possibility of down-draught that might be caused by external weather conditions. The chimney effect produced is enough to create the proper suction and the cowl hood serves to prevent any air from entering. This type of ventilator has proved very successful, and is built along the ridge the full length of the dyehouse.

Some mention of the difficulties experienced at the Firth and Foster Co.'s plant before installation of ventilating apparatus is typical of many others. This company dyes, bleaches, and finishes dress goods. Troubles were experienced for many years with steam in the dyehouses, the steam in some parts being so thick that an electric light 15 ft. away could hardly be seen. The men had to grope their way around with consequent slowing up of production. The steam also condensed on the ceiling, on the shafting and on other machinery, causing rapid deterioration. After condensation it dropped off and spotted the goods, causing serious trouble with the lighter coloured goods. In the winter time when condensation troubles were at their worst, it was necessary to run the lighter shades for spring and summer wear. Hoods were tried over the dye kettles, but spotting still occurred.

To overcome these conditions two ventilating systems were installed, one for the colour dyehouse and one for the black dyehouse. The equipment in the former consists of one No. 9 Buffalo Supply fan with a capacity of 35,000 cu. ft. per minute, and one No. 9 Exhaust fan of the same type with a capacity of 28,000 cu. ft. per minute. The dyehouse is approximately 65 by 70 ft. in size.

The air is drawn in from the outside and forced over the heating coils, leaving the fan at a temperature of about 140°. It then travels throughout sheet steel ducts and is discharged at various points, usually about 9 or 10 ft. above the floor level. There is a discharge directly above each of the eight dye kettles, as well as at the other points around the room. In the black dyehouse the equipment consists of one No. 8 Buffalo Exhaust fan with a capacity of 33,000 cu ft. per minute. This room contains 14 dye kettles and is approximately 90 by 42 ft. in size.

Roof Depreciation

In this case an old wooden roof was replaced with one of steel and terra-cotta. Steel roofs were impossible before because of rapid corrosion. The new roof, it is estimated, will last at least 50 years, whereas the former wooden roof would not be good for more than 10 years under the old conditions. As each dyehouse roof is worth at least $2,000, the annual depreciation on both roofs would be on a 10-year basis, $400. On a 25-year basis it would be $160, a net saving of $240 a year.

A saving of considerable importance is that due to the elimination of spotted goods. This particular item of cost saving totals a minimum of 3 per cent. The loss from spotting was mostly confined to the lighter shades, these having to be worked over or re-finished into a darker shade at a cost of about 2 cents a yard. These percentages do not take into consideration the increased life and decreased repairs on dyehouse machinery, nor the decreased labour turnover due to the more pleasant working conditions.

The experience of ventilating engineers has taught the advisability of installing engine-driven fans with equipment of this kind, preferably direct connected, this method being economical and permitting of a wide speed variation. In the case, however, where the location desired for the fan apparatus is such that little attention is required for its operation, it is preferable to connect the fans direct with a motor. The rapid success attained in ventilating work of this kind proves that this field is still but in a formative stage.

The Silk and Rayon Guide

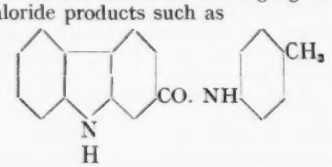
"THE Silk and Rayon (Artificial Silk) Directory and Buyers' Guide of Great Britain," by Arnold H. Hard (London and Manchester: John Heywood, Ltd., pp. 269, 21s.), appears in its 1926 edition in a much enlarged form, containing about three times as much information as the first edition. Of the two parts into which the volume is divided, Part I contains, among other things, a number of articles on special aspects of the industry, such as the silk industry in France, the construction of artificial silk factories, the numbering of artificial silk, the working of viscose silk, etc. Other features are lists of towns and villages in the United Kingdom, giving firms manufacturing or using silk or artificial silk; a list of the artificial silk producers of the world, with much information concerning them; and a list of trade associations. Part II is the buyers' guide, and contains lists of firms dealing in every conceivable requisite of the silk and artificial silk industry, including raw materials, yarns, fabrics, goods, machines and accessories, chemicals, dyestuffs, wood pulp, packing materials, and so forth. The book closes with indexes to towns and villages and to the trade names of artificial silk and silk yarns, fabrics and goods.

Dyes and their Application: Recent Technical Progress

By L. J. Hooley
Scottish Dyes, Ltd., Grangemouth.

Sulphur Colours

CARBAZOLE derivatives suitable for the production of sulphur dyestuffs of the indophenol type by the usual method of condensing with nitrosophenols and then sulphurising are obtained from carbazole carboxylic acids in B.P. 243,557 (Bayer). By combining these acids with amines in the presence of a solvent and a condensing agent such as phosphorus trichloride products such as



may be obtained, or similar substances having both hydrogen atoms in the amino group substituted. The compound given above on treatment with *p*-nitrosophenol in sulphuric acid, followed by boiling with alcohol, sodium sulphide and sulphur dyes cotton from a yellow hydrosulphite vat in fast bluish black shades.

Other blue to black sulphur colours are obtained from amino carbazoles by treatment with dihydroxy bodies and alkali-polysulphides, the reaction being carried out under pressure. As the sulphide itself is capable of acting as a reducing agent nitrocarbazoles may be used and also certain quinones such as benzoquinone. F.P. 558,874 (Kalle). The products, like the other carbazole sulphur colours, are fast to chlorine, and distinct from the majority of sulphur dyestuffs which on account of the ease with which sulphur is oxidised are deficient in this important respect.

For the dyeing of sulphur colours on silk, the old difficulty of the alkalinity of the bath is dealt with in U.S.P. 1,551,330 (Remlein) by adding sodium hyposulphite and bisulphite to the dyebath along with gum soap.

In comparison with the other dyestuff series very little is known of the constitution of the sulphur colours, and during recent years there had been little further elucidation, considering the amount of work which is required to be done. A paper in the current issue of the *J.S.D.C.* (p. 76, *et seq.*), H. H. Hodgson, deals with the action of sulphur on the mono-chloranilines, along with the mechanism of thionation and the structure of sulphide dyestuffs. Other papers by the same author dealing with sulphur derivatives have appeared in the same journal.

Four sealed notes of Scheunert and Frossard dated 1907 and 1908 describing methods of producing resists under sulphur and other vat dyes are reported on in *Bull. Soc. Ind. Mulhouse*, 1925, pp. 551–557. White resists are obtained by printing with manganese chloride, zinc oxide and gum, and coloured resists by adding suitable dyestuffs to the same resisting paste; only such dyestuffs as can be used along with the zinc and manganese compounds can of course be employed.

Diphenyl Methane Dyestuffs

Diphenyl methane intermediates are formed by condensing two molecules of a chlor benzoic acid with one of formaldehyde. D.R.P. 416,544 (Weil). Products from *o*- and *p*-chlor benzoic acid are described, the reaction taking place on standing in cold sulphuric acid.

Fluorescent shades stated to be fast to light on silk and cellulose acetate are obtained by condensing diphenyl methane colours with phenyl methyl pyrazolone or nitromethane. F.P. 589,745 (Hugel). Products from Thiopyronine and Acridine Orange are described.

Leather

Salt and McCandlish in the *J. Soc. Leath. Trades Chem.*, 1925, pp. 518–525, give the results of systematic investigations into the dyeing of leather. With vegetable tanned leathers, the effect of the usual additions of acids and salts in acid dyeing are described. A previous statement that acetic acid is not so suitable as sulphuric was found to be wrong, and in fact with certain colours more even and level shades are obtained. Chrome leather has much greater affinity for acid and direct colours than the vegetable tanned. If the chrome leather is also mordanted the affinity is less, but the resulting decreased rate of absorption gives more level results. For basic colours mordanting is necessary.

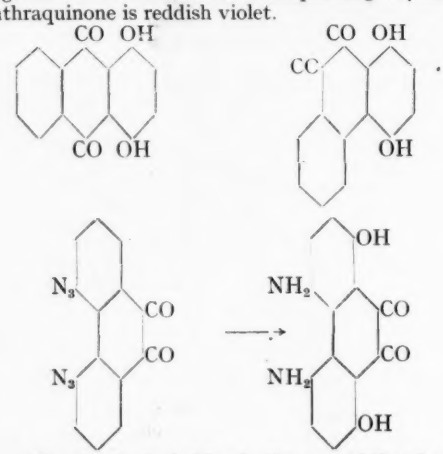
Brown trisazo dyestuffs for leather are obtained, according to U.S.P. 1,565,344 (Vossen), by coupling resorcinol first with diazotised sulphanilic acid, then with diazotised 1-amino-8-naphthol-4-sulphonic acid, and finally with diazotised *p*-nitraniline.

Leather and other animal fibres are given an increased affinity for dyestuffs by treatment with ozone, and the resulting dyeings are faster. The goods after wetting out with ammonia are hydro-extracted and then treated for several hours with air containing a low percentage of ozone. Any acidity which may be developed in the process is destroyed by further washing with ammonia. E.P. 242,027 (Wilkinson).

Salts of metals such as zinc, aluminium or copper are used along with acid or direct dyestuffs in D.R.P. 417,209 (Kalle). Sulphite cellulose waste liquor or the salts of weak organic acids are added to prevent precipitation of the dye by the metals.

Phenanthraquinone Compounds

Although derivatives of phenanthrene have not been used technically as in the cases of those of benzene, naphthalene and anthracene, they possess interesting possibilities tinctorially. Comparing the simple derivatives of phenanthraquinone with the corresponding ones of anthraquinone, these are found to have much deeper colours. Thus, while quinizarine is orange to red in colour the corresponding 1·4-dihydroxy phenanthraquinone is reddish violet.



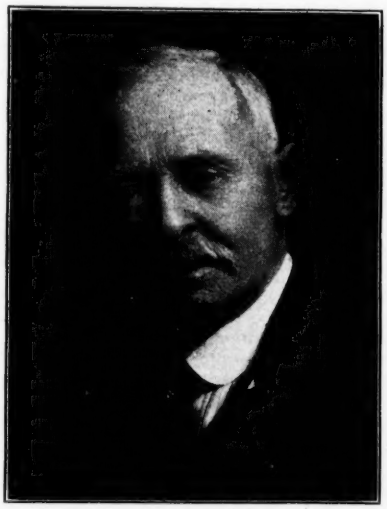
The 2·7-diamino body is blue in the case of the phenanthraquinone and only orange red with the anthraquinone. The deepest colour among the amino hydroxy anthraquinones is blue, but 2·7-diamino-3·6-dihydroxy phenanthraquinone is green, almost black. The dyeing properties are also better, the simpler bodies being apparently much more suitable as mordant dyes than the anthraquinone ones. The production of some of these derivatives is described in D.R.P. Application B. 108,210, by Kurt Brass, who has also dealt with the same subject in *Ann.*, 1925, 441, 217, and *Ber.*, 1925, 58, 204. The method of production is from the amino derivatives, which are diazotised in sulphuric acid and the diluted solution then treated with potassium bromide with formation of the diazonium perbromides which are converted to the azides with ammonia and these then decomposed with sulphuric acid.

Dyestuffs and other substances which are kept in paste form as finely divided suspensions in water are sometimes liable to settle out on standing, especially if kept for a long time, and where the settled matter forms a sticky deposit it is difficult to get the dyestuff into proper paste form again. In Br. P. 247,052, B.A.S.F., this difficulty is stated to be overcome by adding manganese compounds. Examples are given in which a small percentage of potassium permanganate is added to Indigo and Indanthrene dyestuffs. The suspensions are then much more stable, and even if some settling occurs this is not accompanied by coagulation.

The Dyestuffs "Who's Who"

(4.)—Mr. Ernest Hickson

Mr. Ernest Hickson, president of the Society of Dyers and Colourists, and managing director of Hickson and Partners, Ltd., was born at Highgate, London, in 1857. He was educated first at Northampton (where his father was a partner in the boot and shoe making firm of Wm. Hickson and Sons), and then at Hanover, where he spent over three years, attending first the Realschule—the public high school corresponding to our "modern side"—and then the Polytechnicum, where he studied chemistry (under Professors Heeren and Kraut), and physics. After an interval in England he joined a firm of export merchants in Paris. He returned to London after 18 months, and after a short time spent partly at his father's boot and shoe manufacturing warehouse in Smithfield, London, and partly in a tea-broker's office, he began his long connection with the chemical industry by joining the famous colour manufacturing firm of Brooke, Simpson and Spiller as foreign correspondent. This was in 1877, so that he will shortly be able to celebrate the jubilee year of his connection with the industry.



Mr. Ernest Hickson.

Mr. Hickson's interest in chemistry induced him to attempt to obtain technical experience of dyeing and dyestuffs. No facilities were available at the firm's offices in Old Broad Street, and the factory at Hackney Wick was then not very accessible. So under very trying conditions he managed to carry out some work in the office, where gas (but not water) was available. He was able to dye a full range of the firm's colours on wool, silk, and cotton in the intervals of his duty as foreign correspondent. His linguistic accomplishments led to his accompanying a member of the firm through Europe, on a tour of their agencies. Later he travelled in the industrial districts of Western and Central Europe.

In 1883 the firm opened a branch office in Bradford; Mr. Hickson took charge, and has resided in Bradford ever since. The firm was converted to a limited liability company, and Mr. Hickson was made a director. During his agency it fell to his lot to introduce Primuline to the dyeing world. In 1893 he severed his connection with the company, and commenced business in Bradford as a dealer in dyes and dyewares. From 1898 he acted as agent to the Vidal Fixed Aniline Syndicate, afterwards Vidal Dyes, Ltd., Some years later, he assisted in the formation of Rexoll, Ltd., and became managing director of the company, which manufactured sulphur blacks, first at Shipley and later at Wakefield, where Mr. Hickson had acquired a copperas works. In 1914, at the request of the War Office, the manufacture of TNT was undertaken, and as the Wakefield works were not large enough the firm of Hickson and Partners, Ltd., was formed by Mr. Hickson, and a large works was erected at Castleford. Of this company Mr. Hickson became managing director and subsequently chairman. The company now carries on the manufacture of dyes and intermediates.

Mr. Hickson has been closely connected with the Society of Dyers and Colourists ever since its birth, and is one of the few surviving original members. He was present at the inaugural meeting in 1884, was a member of the first council, and has served continuously on that body ever since. He was appointed first chairman of the publication committee, and retained office with one short interval for 40 years. Last year he was elected President of the Society, which office he now holds. When the Colour Index was published, he was presented with a special copy and an illuminated acknowledgment of the fact that the publication of the work was due to his original conception and an enthusiasm which overcame all difficulties. During the war, Mr. Hickson assisted in the formation of the Yorkshire Chemical Manufacturers' Association, which was later merged in the Chemical Employers' Federation. He has acted as honorary chairman of the Yorkshire branch of the latter, and as vice-chairman of the national executive.

Mr. and Mrs. Hickson, who reside at Nab Wood, Shipley, celebrated their silver wedding last year.

Around the Works

(4.)—Williams (Hounslow), Ltd.

In a very interesting way this company is connected with the origin of the British synthetic dyestuffs industry, for it was founded in 1877 by Mr. Lewis Greville Williams and Mr. Rupert Greville Williams, whose father had worked with Sir William Henry Perkin, the discoverer of the first synthetic coal tar dye, "Mauve." The company is one of the oldest established dyestuff manufacturers in the country. Prior to the war it confined its activities to the manufacture of specialities such as nigrosine and induline, of which it was the original, and remains the largest, manufacturer in this country. It is a very considerable tribute to the reputation which it enjoys in regard to these products that in the pre-war period of Germany's greatest power in the industry it was in a position to sell nigrosine in Germany. Of late years, under the supervision of Mr. Francis Greville Williams, the company's activities have been greatly extended in many directions.

On the outbreak of the war, when the country was faced with a shortage of dyestuffs, Williams' undertook the manufacture of a complete range of dyestuffs for many purposes. This work has been developed, and they now make, among many other products, fast dyes for wool, direct cotton dyes, dyes for silk, colours for leather, foodstuffs and confectionery, printing and other inks, soap, rubber, coir yarn, varnish, waxes, boot polish, lake making, etc. The manufacture of large quantities of these diversified products has resulted in a rapid growth of the company's works, which are situated at Hounslow. The older part of the works has been remodelled; the newer part has been erected within the last few years, and operations for its further development are still in progress, the area now occupied being upwards of six to seven times the pre-war area.

Certain phases of the work carried on call for special comment. One of the most interesting branches is that dealing with the production of harmless colours for confectionery and foodstuffs generally. The degree of purity called for in these colouring matters is, of course, far beyond that required in industrial colours. To achieve this purity, and to conform with the regulations covering the use of these substances (for example, the recent regulations of the Committee on Preservatives and Colouring Matters in Food) special precautions are necessary. In this works the manufacture of these products is carried on in a place remote from that in which ordinary industrial colours are prepared; new plant, (involving the use of earthenware, etc.) has been erected to eliminate the use of lead, so that the risk of metallic contamination becomes negligible; while as a still further precautionary measure the manufacture of the requisite intermediates is carried out in a special building. These colouring matters are made so as to conform not only with the regulations existing in this country, but also with those of Canada, Australia, New Zealand, etc.

Another important branch of work is that carried on in the matching department. Here a specially trained staff is engaged in matching the colour of any sample that may be sent in, whereby the needs of any customer may be accommodated. In the laboratory of the company research is being carried on for the development of new methods of production and of new standards of purity for colours.

At this time of industrial depression it is pleasant to note the air of optimism which pervades the works. The output is large, and the company is in the happy position of selling its products not only in the home market, but also abroad, in Australia, France, Switzerland, Spain, Holland, and elsewhere.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

Manchester, April 8, 1926.

THE slight improvement in the consumption of dyestuffs by the cotton industry which set in during February has continued throughout March, and there is a more optimistic feeling than was the case earlier in the year. The improvement is most marked in the higher-priced specialities such as vat colours, and this conveys the suggestion that trade in specialty and novelty fabrics, involving higher technique in manufacture, is expanding, whereas trade in lower quality materials, where price is the paramount factor, shows no improvement.

Mr. Christie, of the United Turkey Red Co., is the latest exponent of the theory that the high price of dyestuffs is the outstanding cause of the poor state of trade. Another suggestion which is receiving more attention than it deserves is that too many styles are made and that the example of Henry Ford should be followed in the textile industry. If literally followed out, the suggestion should obtain the dyestuff manufacturers' approval, for black does at least mean the consumption of a large amount of dyestuff. But, joking apart, surely the Henry Ford idea used to be described as the typically British and bad " take it or leave it " attitude.

When greater minds have failed to diagnose the case, one yields to the temptation of suggesting that a manufacturing system which permits spinning, weaving, dyeing or printing or bleaching, and finishing, packing, and merchanting to be dealt with as separate industries, carried out by separate concerns, often situated in different towns, is somewhat handicapped in these days of strenuous competition. One would like to know how many profits a cotton piece can yield, and how many miles a cotton fibre travels between the time of reaching the Manchester Docks as raw cotton and leaving the Manchester Docks as dyed piece goods.

The Artificial Silk Exhibition at Holland Park, London, opens on April 19 and should be of great interest to those who wish to see the wonderful effects which the ingenuity and skill of the British manufacturer has produced with the aid of the synthetic fibre.

Yorkshire

Bradford, April 8, 1926.

March in its opening week promised well for the dyestuff and intermediate trade, but as the month drew to a close orders tailed off considerably. This may have been due in some measure to the stocktaking which takes place in many works at this season. The Spanish Royal Decree of March 11, prohibiting the importing of dyestuffs and intermediates into Spain, was made and operated with such suddenness that in at least one works in the West Riding of Yorkshire intermediates on order and already packed for export to that country were thrown on the makers' hands. The Dewsbury heavy woollen trade feels most seriously the Australian tariffs. The prices of cheap suitings and overcoatings which this district used to send to Australia in considerable bulk are rendered prohibitive by the duties. Then, too, the Canadian market is furnishing fewer orders than has been customary. In the Huddersfield trade a slight improvement is reported in most departments. A large Italian firm of artificial silk manufacturers, having in view the establishment of a factory in the North, have been informed of sites on both the Yorkshire and Durham sides of the River Tees, and it is the intention of the directors to examine them.

In consequence of the new internal reconstruction of the I.G., some of the leading directors have been over and busy in the north of England rearranging the organisation of the sales. The intention seems to be to concentrate this in comparatively few hands, and out of the enormous number of salesmen which all the units such as the Badische and other firms had both in Lancashire and Yorkshire, the weeding out looks like being a difficult and painful task, causing much heartburning. At one time it was rumoured that each of the old units should take over one country and that Cassellas were to handle England, but that idea seems to have gone by the board.

Prices of intermediates remain at about the same levels as last month with some slight hardening of those of benzol and solvent naphtha.

Midlands

Leicester, April 8, 1926.

The slight improvement in the principal dye-consuming trades experienced during the first two weeks of March has not been maintained.

Buyers of all kinds of hosiery appear to have adopted a hand-to-mouth policy from which they will not depart, thus depriving dyers of anything in the way of real bulk. This may be accounted for by the fact that fashions in hosiery now change as quickly as in any other articles of clothing, whereas in pre-war days 90 per cent. of the hose and half-hose manufactured in the Midlands was dyed in four shades—black, tan, nigger, and navy.

Artificial silk and cotton hose are selling better than other classes, and there is a reasonable demand for knitted artificial silk fabric for underwear; nevertheless yarn agents dealing with this fibre complain that orders are small and new business is very difficult to get. It is hoped that the Artificial Silk Exhibition to be held in Holland Park this month will help to swell the volume of trade. In view of the importance of this fibre in the hosiery trade it seems strange that very few firms from the Midlands are exhibiting.

In the wool section hose and half-hose are very quiet indeed; a few orders for knitted wool fabric for ladies' dresses and sports wear are being booked. One firm of wool spinners secured a fairly good Government contract, but most spinners are making short time.

We referred two months ago to the price-cutting campaign amongst hosiery dyers and finishers in this district. One fairly old-established house has gone into liquidation, and many well-informed people are of the opinion that, unless volume increases, other hosiery dyers and finishers will be hard pressed to meet the present high overhead charges. During and since the war most dyers enlarged their dyehouses and improved the capacity of their machinery, and a good many new firms have started. The demand for hosiery has not increased in the same proportion. It is reasonable, therefore, to assume there will be a weeding out process, and that the fittest will survive.

Scotland

April 8, 1926.

The volume of business in dyestuffs remains fairly steady, with perhaps some falling off in Scottish orders, balanced by increases in other directions. There had been an increased demand for the vat blues, of which some very satisfactory types are on the market at the present time. The Easter holidays may be expected to create a slight disturbance in sales, but the effects in Scotland are less than in England, although this year the Glasgow holiday coincides with Easter Monday.

The old established Craigton bleach works of Blackwoods, Ltd., have been closed down, the work and personnel being largely transferred to one of the company's other branches. Henderson, Hogg and Co., of Glasgow, have recently taken charge of the Scottish interests of the British Alizarine Co.

All the interests concerned having had time to voice their opinions and criticise, the general impression created by the arrangement between the B.D.C. and Scottish Dyes, Ltd., can now be estimated. Reports from this country and abroad appear to regard the move as sound policy, and comments have been universally favourable, nor has Scottish feeling reason to be anything but gratified by the disclosure of the reputation which the Scottish dye firm enjoys outside Scotland.

The amalgamation of the German interests has created a more optimistic feeling abroad. That the I.G. Farbenindustrie Aktiengesellschaft is not going to allow the grass to grow under its feet is shown by the proposal to set up a registered limited company in Britain with head offices at Manchester for the purpose of competing for a greater share of the trade of this country than has been recently enjoyed. It is interesting to note also that the Patent applications of the various constituent firms have now for several weeks been coming in under the new I.G. designation. It is clear that the task of the British dyestuff industry is not to be made easier by any lethargy on the part of its rivals.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, *8, Bouverie Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions on current problems will be welcomed*

The Great Strike

WHEN our last Monthly Dyestuffs Supplement was issued the industry was anxiously contemplating the possibility of a coal strike, hoping that it might be averted, but fearing in advance the consequences of such a catastrophe to the trade of the country. The strike came, but it was on a much larger scale than any one had anticipated. The calling out of the entire trade union membership of the country had the effect of momentarily paralysing the normal services, but with amazing speed and resource temporary machinery was organised, and after the first few days the fear of national disruption had passed, and it became only a question of days before the end came. When it did come there was a sense of profound relief, and, almost incredible as it is, there appears throughout British industry, and indeed throughout the nation, to-day a better spirit than we have known for some time past. The messages from the King and from Mr. Baldwin contained a challenge to the nation which has been splendidly responded to by all parties, and, lamentable as the loss and damage must be, some compensation will be found if all parties henceforward work loyally together for the common good. In consequence of the strike our Dyestuffs Supplement appears a fortnight late.

Dr. Armstrong's Review

IT was a compressed and yet comprehensive review of the present position of the British dyestuffs industry that Dr. E. F. Armstrong presented at the annual meeting of the British Science Guild on April 29. No statement of recent date has contained so many reasons for congratulation and hope or has been supported by more direct authority. In spite of the enormous difficulties that Dr. Armstrong shortly outlined he describes the industry to-day as "virile in the highest degree." Not only are the larger number of the many known dyestuffs manufactured in adequate quantity and of entirely satisfactory quality, but the accumulated experience is enabling the forward progress to-day to be more rapid than at any other time. The days of painfully toiling in the wake of others are passing, and in the new fields opening to the dyer this country is more than holding its own. A year or so hence, we may confidently expect to have reached and consolidated a very strong position. It is, indeed, satisfactory to hear from so good an authority that the standards reached by the British maker in regard to dyeing properties, strength, and shade are in most cases higher than those of the Continent in the prime of pre-war days. When one sets in the right perspective the enormous achievements of the last few years, the grounds for complaint and criticism at once assume a diminishing proportion.

A New Application of Dyestuffs

IN the issue of THE CHEMICAL AGE for May 1 Dr. G. N. White gave a brief account of a new process, in which dyestuffs are applied to the coloration of concrete and other building materials. Since then we have had the advantage of some discussion with Dr. White concerning further aspects of the matter. Among these was the effect this new application might have upon the output of dyestuffs in this country. Considering vat dyes, which are generally the most suitable for this method of coloration, owing to their chemical properties and general fastness, it is understood that the output of vat dye pastes is, in round figures, about 1,000,000 lb. per year. Assuming that the concrete coloured contains 0·2 per cent. of actual dyestuff, or, say, 2 per cent. of paste, 1,000,000 lb. of paste would tint about 25,000 tons of concrete. Assuming, further, that 1 cwt. of concrete is sufficient for 1 square yard of surfacing mixture 1 inch thick, this weight of coloured concrete would be sufficient for 500,000 super yards, which is an area afforded by a number of the order of 2,500 large or 5,000 small houses. This is a rough calculation which indicates that it is not beyond the bounds of possibility that the application of vat dyestuffs to the coloration of concrete could in time double the present output of these dyes. The effect of this widening of the market for dyestuffs could not have other than a beneficial effect, and would, in particular, give a stimulus to the manufacture of vat dyes, which, as is well known, is a highly specialised branch of the industry, and one in which British manufacturers have made notable achievements. It is not unreasonable to expect that the increased output of dyestuffs which would be necessary if the new process became established might, in time, give rise to a substantial reduction of costs, which would be welcomed alike by the dyeing, dye manufacturing, and building industries.

Affinity of Cement for Dyestuff

ALTHOUGH the idea of colouring concrete is not new, no reference, as far as can be ascertained at present, has been made in the patent or other literature to a process of the kind now initiated. A fact worthy of note, and one that might have been expected, is that cement exerts, as it were, an affinity for the dye, although this affinity is due to causes totally different from those obtaining in textile fibres. It is thus the cement alone, in concrete, which is coloured, and this helps to explain the fact mentioned in Dr. White's article, that the depth of shade is proportional to the ratio of dyestuff to cement, and not to the ratio of dyestuff to total concrete. It is becoming generally recognised that concrete is the building material of the future. In the last two years 26,000 concrete houses have been built, and in addition the material has been widely used in other building and structural work. In houses especially the one disadvantage of the material, from the point of view of the architect and the public, has been its unpleasant drab colour, and efforts to overcome this disability have been only partially successful. The opportunity of using dyestuffs to this end enables the architect to have at his disposal a range of tints which is to all intents and purposes unlimited, and the opinion is expressed by competent authorities that this will result in the employment of concrete in architecture on an increased scale.

Financial Aspects

THE cost of colouring concrete with vat dyestuffs is understood to comply with the usual commercial standards for the greater part of architectural work, but unquestionably if it can be lowered the stage when the use of coloured concrete doubles the output of dyestuffs would be brought proportionately nearer. The cost of colouring one super yard of concrete one inch thick (consisting of one part of cement to three parts of sand) to give a pastel shade will be about eight shillings. Variations in the depth of shade, the tint, and the thickness of the surface rendering will obviously give rise to a variation in cost,

but the above figure may be looked upon as an average. So far as can be ascertained at present vat dyestuffs in concrete will be at least as fast as when in a fabric. For internal purposes a thin wash of coloured cement of the recently developed type can be employed, and in this case the cost is found to compare favourably with other methods of wall decoration. In regard to a building scheme involving the erection of 1,500 houses in the north of England, the specifications provide for the use of cement in this way, and the internal walls, instead of being finished in cement and then distempered, will be simply finished in coloured cement. It is estimated that the elimination of distempering in this way will effect a saving of between ten and twenty thousand pounds. It is expected that the colours will be much more lasting and the surfacing more durable than would otherwise have been possible.

Taking a general view of this new work, it seems to have the prospect of becoming a very appreciable help to the British dyestuffs industry at an opportune time, while placing at the service of the building industry an improvement which may lead to important developments.

New Colours

THE B.D.C. have recently brought out two important acid colours, Lissamine Red B and Alizarine Sky Blue B. Both are level-dyeing fast-to-light colours suitable for self and mixed shades. The former is designed to replace the previously used Azo Geranine 2G to which it is superior, while the latter, which is practically unaffected by chroming, is of special value for use in conjunction with chrome-mordant and acid-chrome colours. A new direct yellow, Chlorazol Yellow 6G, gives brilliant greenish yellow shades and can be used for cotton, silk and union materials. An addition to the B.D.C. Monolite Series of lake colours is Monolite Yellow 5G Lumps, which is considerably greener than the G Lumps. It possesses a very high degree of fastness to light, oil, water and alkali, and is suggested as a substitute for chrome yellow where the poisonous nature or sensitiveness to alkali of the latter precludes its use. It can be used as an oil colour, as a colouring medium for high-class wall papers, surface papers, and distempers fast to light and lime, as an artists' colour and for lithographic inks, especially for three colour process work. Being practically insoluble in spirit, it is fast to varnishing.

Celatene Scarlet is the latest addition to Scottish Dyes' colours for acetyl silk, giving bright red shades bluer than Celatene Red.

A new direct dyeing vat black, Paradone Direct Black R, and a similar grey, Paradone Grey B, have been announced by L. B. Holliday.

Hickson and Partners, Ltd., Bradford, forward the second of their series of pattern cards, namely, No. 4b, showing samples of cotton yarn dyed with their Sulphur Black D.S. powder, in baths of various strengths, the figures for which are given.

Bradford Dyers' Strike Settlement

ONE of the important side-issues of the general strike was the situation which arose in the Bradford dyeing industry. When the strike was declared, the transport workers who are employed by the Bradford Dyers' Association, Ltd., and who are for trade union purposes included in the Amalgamated Society of Dyers, were called out along with transport workers in general. After a day or two some of the transport workers employed by the Association returned to work, whereupon the operative dyers were called upon not to handle any goods entering or leaving the dyehouse. Later on the whole of the operative dyers in the district connected with the Amalgamated Society of Dyers were called out on strike, the number of men involved being six or seven thousand. When the general strike was declared off, the men employed by the Bradford Dyers' Association were not permitted to resume work at once and unconditionally, and in consequence dyers employed by other firms remained out on strike. As a result of negotiations between the Amalgamated Society of Dyers and the Bradford Dyers' Association terms of settlement were agreed upon. According to these terms, the men will be taken back as soon as work can be found for them, but the legal rights of the Association are in no way prejudiced by this, and they propose immediately to begin a legal action against the Amalgamated Society of Dyers to enforce their rights under the existing agreement. They intimate, however, that if work is resumed, and the dyers' society consents in open court to a declaration that the above agreement is binding on both parties until legally terminated, they will forgo all claims except £100 and their full costs. Under the agreement in question the Association have a right to claim a penalty of £1 against each employee who left work, but they will not enforce these personal penalties. The settlement does not extend to persons guilty of intimidation. As a result of the settlement, conditions in Bradford became normal, except in so far as they are affected by the coal shortage.

Dyeing and Printing in India

ACCORDING to the Annual Administration Report for the year 1924-5 of the Department of Industries of the United Provinces, dyeing and printing are very important industries, but have not yet made great headway in spite of the most strenuous efforts made by the Government School of Dyeing and Printing, Cawnpore, which holds demonstrations every year at industrial fairs and at important dyeing centres through the peripatetic school. One reason seems to be that it is not adequately realised that dyeing is an art requiring highly technical skill. It is not possible for untrained persons to obtain the required effects with artificial dyes which have now largely taken the place of vegetable dyes. The cottage weaver has begun to realise that his trade suffers from the unskilled use of unsatisfactory colours and, though interested in new methods, he cannot leave his loom to get a training in the art of dyeing. There is no difficulty now in obtaining synthetic dyes in large packings, but an organisation is needed for the supply of dyes to village dyers in small packings. The chief need now is men trained in the use of artificial dyes who would go back to districts. It is not possible for the weaving industry to progress without an extension of the dyeing industry on modern lines. Some of the best products of weaving schools and weaving factories fail to fetch good prices because the colours are fugitive. It is therefore necessary to make suitable arrangements for the supply of good dyes. The industry at Farrukhabad, the chief centre of the printing industry, received great impetus from the sales at Wembley.

Dyestuffs and Coal-Tar Products

THE fourth edition (revised) of *Dyestuffs and Coal-Tar Products* (London: Crosby Lockwood and Son, pp. 168, 16s.) has just appeared. It forms No. 1 of the Manuals of Chemical Technology, edited by Dr. Geoffrey Martin, and is a composite work by the editor, Dr. F. Challenger, Dr. H. J. S. Sand, and Mr. T. Beacall. The eight chapters of the book deal with the industries of coal tar and coal tar products, of the synthetic colouring matters, and of natural dyestuffs; the dyeing and colour-printing industry; modern inks; saccharine and other sweetening chemicals; the industries of modern synthetic drugs, and of photographic chemicals. The chemistry, manufacture, and application of the substances mentioned are discussed. References are given to the literature, and the chapters are preceded by lists of books dealing more exhaustively with the subject than is possible in short compass. In this edition efforts have been made to bring the subject matter up to date.

The British Dyestuffs Industry: Progress and Prospects

By Dr. E. F. Armstrong, F.R.S.

One of the features of the annual meeting of the British Science Guild on April 29 was an address by Dr. E. F. Armstrong, F.R.S., on "Dyestuffs." It is so complete and compressed a review of the present position that we have pleasure in publishing it in a complete form.

THE manufacture of dyestuffs is undoubtedly the most complex task that the technical chemist has undertaken, and it is little short of a marvel that the production of these commodities at the price and of the quality demanded to-day by the dyer has been achieved. As is well known, the first synthetic dyestuff was an English discovery; the industry, started here, passed before long to Germany, where it prospered and grew to what was practically a world monopoly. It prospered because the Germans were willing to appreciate and to apply scientific methods and results; it prospered also because there came forward as commercial leaders men of the first rank who had been trained as scientists, and were able, in consequence, to understand the problems and the point of view of the technical workers in the industry. And so the dyestuff industry grew till it became something much greater—a synthetic organic chemical industry, making medicinal chemicals and drugs and many other important synthetic substances of everyday use; it also became a potential arsenal for chemical warfare.

Lessons of the War

Then came the War, and we in Britain and our Allies learned what the production of munitions and what chemical warfare demanded, and we had to improvise. Many were the mistakes, paid for in human life and treasure, but right well was the work done by our chemists, and the country can never repay, nor should she ever be allowed to forget, the debt she owes to them. The lesson was clear—never again must the safety of the country be left to improvisation; an organic chemical industry must be created and protected in its infancy against the inevitable attempts that would be made to destroy it.

Our Allies had a similar experience and, particularly in America and France, took steps to safeguard the future. But those who have no interest in the manufacture of dyestuffs have short memories and would thoughtlessly mortgage the future for the sake of the profit of the moment. The fight, therefore, is not yet won. It is easy to decide to create an industry, but when success depends so much more on experience and leadership of a particular kind than is the case in any other industry, the initial mistakes must necessarily be many and the period in leading strings a protracted one.

A Fine Record of Progress

To-day, one has to report progress, to justify the efforts made, to express optimism as to the future; above all, to urge that we must understand and appreciate the lessons which experience in the synthetic chemical industry has taught, lessons which it is the special object of the British Science Guild to propagate, namely, that in industry to-day the application of scientific method is essential to technical success, though it is more than ever true that without commercial prudence and ability, complete success is unlikely. Just as much as we ask the business man to understand and appreciate science, and urge that the nature of the education in the schools and universities be modified accordingly, so we must urge on the man trained in science to be practical and have an eye to the commercial value of his knowledge and methods, for knowledge by itself is dead and may be pure selfishness. It is by its application that the world benefits.

The dyestuff industry in Britain has not been without its critics, but by those in a position to judge, its progress, all things considered, is regarded as a real achievement. A highly technical industry had to be built up practically from the beginning. Primary materials, intermediates, and finished products all had to be made economically and of the desired quality by methods which had to be rediscovered by British chemists working literally against time. Hardly anyone in this country possessed practical knowledge or was found able to apply it when confronted with the searching test of practice. Yet to-day the industry is virile in the highest degree. By far the larger number of the many hundreds of known dyestuffs are manufactured in adequate quantity and of entirely satisfactory quality, whilst the accumulated experience is enabling the forward progress to-day to be more rapid than at any other time. The harvest of research ripens slowly. The industry is finding its faith in research justified and has begun to reap in fuller measure the rewards of intensive and prolonged investigations. The days of painfully toiling in the wake of others are passing, and in the new fields opening to the dyer we are more than holding our own. So that a year or so hence we may confidently expect to have reached and consolidated a very strong position.

The Price Factor

The price of the dyes made in England in relation to world prices is a more controversial subject. In considering it, the existence of reparation stocks from Germany in part seized at low prices, as also of stocks made in Germany at the period of the inflated mark, must be taken into account, as well as the invalidity of comparisons with colours quoted in heavily depreciated currencies. Almost always, from the ultimate point of view, the discrepancies between our own and foreign prices are not so serious, and they should be remedied largely by the reductions which all the time are taking place as the result of factory improvements and research.

The dyestuff industry is protected in this country not by a tariff but by absolute prohibition of the import of dyes and intermediates except under licence. A licence can be granted if the colour is not made in this country, or if it has not the requisite shade or properties, or if the price is considered extravagant in relation to pre-war costs of the colour. The President of the Board of Trade, in administering the Act, is advised by a committee on which the users of dyestuffs have a majority, aided by technical experts. It is significant to note how few licences are granted on the grounds of quality or price.

It is not enough to make the dyestuffs and to supply them absolutely true to standard in regard to dyeing properties, strength, and shade: the standards reached by the British maker to-day are in most cases higher than those of the Continent in the prime of pre-war days. In addition, the colour maker has to maintain a very complete technical service, so as to show the user in the majority of cases how best to apply the colours so as to get the results he requires and also, in many instances, how to follow the dictates of fashion in new directions. The colour maker, indeed, has to do much of the technical research for the colour user; he has to be an expert in cotton and wool, fur and straw, rubber and paint, and much else. It may justly be claimed that in these circumstances the price of dyestuffs which, on the average, bring to the manufacturer less than tea does to the tea planter, is one of the miracles of applied science.

Uses of Rock Asphalt

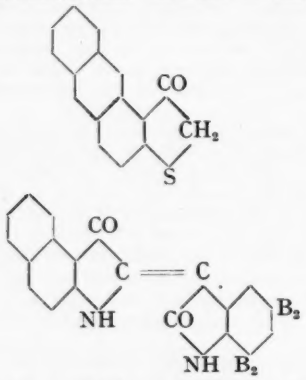
IN dyeworks and textile mills it is essential that foot and vehicular traffic should proceed as smoothly as possible, broken floors and pavements leading to much delay in trolley and similar traffic, and to unnecessary wear and tear of the vehicles. Mastic rock asphalt may be advantageously used in these and other cases as a floor construction material, and repairs may also be readily carried out by its means. It is watertight, dustless, noiseless, resistant to wear, and warm and comfortable for standing on. It is useful for overlaying wood floors, such as in ball or skein warp bleaching and dyeing departments, where warps must be lifted from the floor, the asphalt surface being non-injurious to the fingers, whereas wood floors offer danger from splinters, etc. Its water-tightening properties make it valuable for the lining of brick, stone, and other tanks. These and other applications of rock asphalt are described in a booklet issued by John Dickinson and Co. (Bolton), Ltd., of Fairclough Street, Bolton, who also manufacture and lay a special acid-resisting asphalt, "Aciteneo," which finds application in laboratories and elsewhere.

Dyes and their Application: Recent Technical Progress

By L. J. Hooley
(*Scottish Dyes, Ltd., Grangemouth*)

Indigo Dyestuffs

ALTHOUGH only one or two indigo dyestuffs of the anthracene type, such as Alizarine Indigo G and Thioindigo Blue 2G, have been actually put on the market, several others have been described in the literature, and it will be recalled that indanthrene was an accidental result of an attempt in this direction. A recent patent of the Soc. Chem. Ind. Basle (B.P. 246,165) gives methods for the preparation of anthracene 2.1-thioindoxyl, the intermediate for the dyestuff corresponding to Thioindigo Red. Anthraquinone-2-glycollic acid is reduced with zinc dust and ammonia to anthracene-2-glycollic acid, or this latter body is obtained from anthracene-2-mercaptan by condensation with chloracetic acid. The glycollic acid on treatment with aluminium chloride undergoes ring closing with formation of the thioindoxyl. Unsymmetrical naphthalene indigos are described in two other patents of the same company (D.R.P. Anm. G. 61,336 and 60,465). In the latter β-β-naphthothiofuran 1.2-dion is condensed with

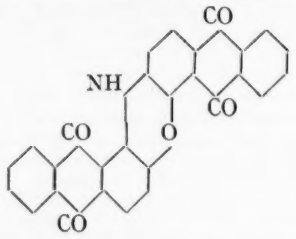


cyclic compounds containing reactive methylene groups. In the other 2.1-naphthindoxyl and halogenated isatins react to give compounds which are probably of the indirubin type. The product from 5.7 dibrom isatin gives brown shades.

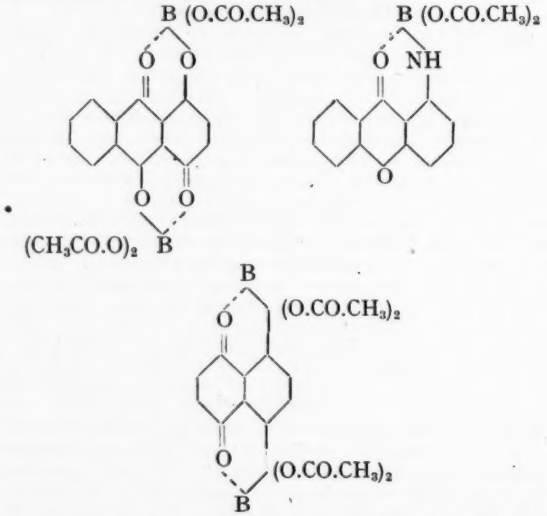
A note on the synthesis of indigo (*Chim. et Ind.*, 1925, 852) gives a method by Lepetit from the formaldehyde bisulphite compound of aniline, described in a sealed note in 1900. The aniline compound is converted to the glycine nitrile with cyanide, and given an alkaline fusion.

Anthraquinone Products

There is no sign of any diminishing interest in the anthraquinone derivatives. Even excluding compounds such as the benzanthrone type, which are now sufficiently important to be considered apart, the number of patents appearing is considerable. Those of the anthraquinone dyes which have been used for wool have almost without exception contained only one anthraquinone molecule. The wool dyer requires for his acid dyes products which are not only soluble but also level dyeing, and this is one of the reasons why, although practically any cotton dyestuff which can be sulphonated, can be thus converted to a wool dye, the number which are thus used is limited. Levelling properties are generally improved by hydroxy groups and amino groups, as well as methylamino and dimethylamino. Alizarine Delphinol and Solway Blue are particularly well off in this respect, and it is this property in addition to the fastness to light and brightness which accounts for their extensive use and popularity with wool dyers. Dyestuffs containing two anthraquinone molecules, e.g., sulphonated dianthraquinonylamines have been described recently, although these are not entirely new. In U.S.P. 1,564,091 (Graselli D. C., Mieg and Roeder) the sulphonation is carried out under conditions which produce hydroxylation at the same time, by heating with oleum at temperatures of 120° C. and above. From the 1.1′ and 1.2′ dianthraquinonylamines brownish and blue shades are obtained. They can naturally also be chromed. The hydroxy groups enter the 1.1′ derivative in the ortho position to the amino linkage, as they give substituted oxazine derivatives as shown in the formula, on further treatment with acid.



The production of quinizarin from orthochlorphenol has already been alluded to, and in B.P. 248,874 (U.A.C., Dodd and Sprent) the quinizarin is utilised by condensing with *p*-chlor aniline, giving products which are probably analogous to Alizarine Cyanine Green and Alizarine Irisole obtained by the use of *p*-toluidine. It has been found, however, that while in a nickel vessel both hydroxy groups are replaced, only one is affected when the condensation is carried out in iron. Economy in the production of anthraquinone-2-chlor from *p*-chlor benzoyl benzoic acid is effected by using 90 per cent. D.O.V. at 170° C., the anthraquinone-2-chlor separates on cooling and the filtrates are strengthened with oleum and used again. B.P. 248,411 (S.D.L., Thomas). Alizarine may be produced from anthraquinone-2-chlor by a caustic fusion, and the alizarine separated by taking advantage of its solubility in 20 per cent. soda. The caustic soda may be then used again without separating inorganic matter. B.P. 246,529 (S.D.L., Thomas and Hereward). Boric acid finds considerable application in the synthesis of anthraquinone derivatives, particularly in the production of hydroxy bodies by oxidation or hydrolysis with sulphuric acid or oleum. Its beneficial action is probably due to the formation of boric esters. With the boroacetic anhydride introduced by Dimroth and Faust (A. 1922.1.155), which has probably the constitution of a pyroboracetate, new boroacetic esters of known constitution are formed. These boroacetic esters are only formed with hydroxy or amino groups in peri-positions to carboxyl or similar groups. The compounds formed with 1.5-dihydroxy and 1-amino anthraquinones are shown.



It has now been found that naphthazarin yields a diboroacetic ester and its constitution from the above rule must be as shown, which means that this body is 5.8-dihydroxy-1.4-naphthoquinone and not the 5.6-dihydroxy body as previously supposed. Since this acts as a mordant dyestuff and does not contain hydroxy groups in the ortho position to each

other, it forms, therefore, an exception to the Liebermann-Kostanecki rule. Other exceptions are, however, also known.

Anthraquinonyl ureas have been prepared having affinity for acetyl silk. B.P. 248,858 (B.D.C., Perkin and Hollins). A brown is obtained from diaminoanthrarufin and α-anthraquinone urethane and a steel grey from diamino chrysazine and two molecules of urethane.

Printing

A new recipe is given by Sieber in the March issue of Melliand's *Textilberichte* for an alkaline printing paste which will not attack the printing rollers. This is an additional note to a previous article by the author in the same journal (1925, p. 829). This question has attracted a good deal of attention among printers lately, mainly because of the increasing use of vat colours in printing. The trouble is to be distinguished from the ordinary case of scratching of the roller, due to the accidental presence of gritty particles in the paste, and which may happen with any type of colour. It takes place principally with strongly alkaline pastes and is liable to occur suddenly in the most haphazard ways. In the worst cases it may ruin the pattern of the roller completely in five or six revolutions, in some instances flakes of metal being actually torn off. Very diverse and ingenious explanations have been given, and it seems clear that more than one influence may be responsible (*vide* M.T.B., Reinkung 1923, 427, Drechler 1923, p. 586, Gaumuitz 1924, 313). A most interesting and by no means obvious reason for the trouble is suggested by Sieber in his first paper. According to this author a powerful reaction takes place on mixing the thickening and alkali, as evidenced by the rise in temperature. When the mixing is not carried out properly gummy coagulations are formed, which are highly adhesive and which may form cementations on the roller, and these cementations become so firmly attached that when they are torn off shearing takes place through the copper instead of through the surface of contact. This is a not unknown phenomenon with adhesives. Sieber's method consists of using gums and not burnt starches for the thickening, and carrying out the mixing carefully with external cooling, so that rise in temperature is avoided. In the note referred to at the beginning of this section gum senegal is used, being mixed with caustic soda at 20-22° C.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

The following reports were prepared on the eve of the industrial stoppage, and though the perspective has completely changed since they were written they may still be interesting as a reminder of the conditions and the outlook of the dyestuffs industry then.

Lancashire

TRADE in April was in general very patchy, and quite evidently under the influence of the threat of the coal stoppage. Some of the dyestuff using concerns were closed for the whole of Easter week, and the threatened stoppage was, no doubt, largely responsible for the comparatively small volume of business done towards the end of the month. On the whole, business in dyestuffs for cotton was even less than the moderate March level; for the paper and hatting trades it was good, and for the lake making trades very good.

It is notable that the shades for men's hats are following closely the prevailing vogue for pale shades in ladies' wearing materials, and thus promise no large volume of business in dyestuffs.

It is understood that the British Dyestuffs Corporation's exhibit at the Artificial Silk Exhibition attracted the attention of more than one of the leading London stores, and as a result it has been loaned to Messrs. Selfridge for exhibition during the present week.

It is to be hoped that such immediate success will lead to the adoption of similar ideas by other chemical manufacturers, and it is quite evident that chemical processes can not only be demonstrated but that such demonstrations can be appreciated by the layman.

As a result of the recent fusion the British Dyestuffs Corporation and Scottish Dyes, Ltd., are each offering the whole of the anthraquinone products made by the two firms under the same brand names as heretofore. It is possibly too early to expect cheaper prices, but there is no doubt that such a move would be much appreciated by the users, and probably would be profitable to the makers as there is a good prospect of expansion in the trades using the anthraquinone colours if a little stimulus in the way of lower prices could be given. In connection with prices it is reported that the Colour Users' Association have sent delegates abroad with a view to ascertaining the prices paid for dyestuffs by colour users in the European countries.

Yorkshire

The first week in April opened well with brisk demand for dyestuffs and intermediates. This condition was, perhaps, a result of buying suspended over the quarter end, for it was not maintained throughout the month, orders becoming spasmodic and for "hand to mouth" quantities. No doubt, the industrial uncertainty then existing had largely been responsible. A more hopeful tone prevailed in the Dewsbury district and might have become pronounced but for the coal mining crisis. Manufacturers were proceeding quietly with cloths for next winter's wear. The vogue for velours in the women's trade continued, and several orders for other qualities had arrived from China and Japan. The blanket industry, however, was reported to be in a state so deplorable that living memory cannot recall it in a worse. In Huddersfield the worsted section was improving, but woollens were not showing much in the way of advancement, and the disturbances in China continued to stagnate the Bradford black cotton piece trade and consequently to affect adversely consumption of sulphur blacks.

Of the family of Ripley, which built up the great dyeing business of Edward Ripley and Son, Bowling, the last member to be associated with the dyeing trade, Mr. Henry Ripley, has died in Bournemouth. He was the second son of the late Sir Henry W. Ripley. Always actively connected with the business, he was a partner when it was incorporated in the Bradford Dyers' Association in 1898, when he was appointed a trustee for the debenture holders of the Association. The trusteeship he held up to about three years ago, when serious illness caused him to resign.

Increasing activity in the artificial silk industry is encouraging dyers of all classes in the district to consider the question of adapting their dyehouses and methods to meet the new demands that the marketing of the fibre in its various forms is creating. It exercises the minds of yarn and piece dyers alike, and inquiries for three and even four colour effects obtained in the dyeing of the piece call for concentration on new problems.

Yorkshire was well represented at the Artificial Silk Exhibition held at the Holland Park Hall. The stand of the Bradford Dyers' Association was spectacular and centrally placed near the mannequin platform and many of the models shown thereon had been dyed and finished by the Association. Other exhibitors from Yorkshire were the Bulmer Rayon Co., Ltd., S. W. Whalley and Co., Ltd., and Baldwin and Sons, Ltd. It is reported that large orders were booked.

Those intermediate makers who were enticed into making T.N.T. for the war took marked interest in the publicity the Press gave to the recent reference by the Comptroller and Auditor-General in his comments, on the Navy Appropriation Account for 1924–1925, on the resale to the Navy of that high explosive at an alleged profit of 50 per cent. on the price paid to the Disposal Commission. It is refreshing to know that at least one firm of T.N.T. contractors has been allowed at long last to make a profit. It remains with those who have been bitten to call to mind the predatory "Liability of Explosions Act, 1916," utilised by the then Government and its successors to extract from some of the contractors profits promised as legitimate ones, and that White Papers have recorded that tens of thousands of pounds squeezed out of contractors under the Act are lying in the Treasury against which there has been no legitimate claim, no losses having been incurred since the passing of the Act.

Midlands

To dyestuff manufacturers and Leicester merchants April has been a very disappointing month. There were very few inquiries, and for the small amount of business passing lower prices have been quoted in a number of cases. Any hope of immediate recovery in the volume of trade has been crippled by the industrial crisis.

The demand for artificial silk hosiery which one would expect to be good at this time of the year is decidedly poor. Knitted artificial silk fabric has not suffered to quite the same extent. Novelties in flouncings, bedspreads and fabrics composed of several different fibres and dyed in two or three colours, such as were shown in quantity at the Artificial Silk Exhibition in London, are selling fairly well. Lace curtains and nettings may be said to be quietly steady.

Cotton fabric and hose consisting entirely of cotton have lost ground. Sewing cotton is no worse than a month ago.

Wool spinners are making poor time. Knitted woollen costumes are absolutely dead at the moment—a small demand exists for printed woollen fabric for jumpers.

In the leather section we hear of acute price cutting, competition in chrome calf coming from the Continent. The tanners in this district are not working at anything approaching their full capacity. Until the coal crisis became acute most tanners believed a better time was near.

Scotland

Even before the general strike had begun, and the way to a settlement was still open, it was evident that fears of a possible breakdown had been exciting a restricting influence. At practically all the principal houses business was reported as extremely quiet with little in the way of new orders. But for this disturbing atmosphere the month would probably have been a moderately good one with little cause for complaint in comparison with the two or three previous ones. The woollen trade was fairly normal with work on next winter's orders, and although it was not so good as some of the optimists had promised the discrepancy was not a wide one.

The hosiery section was generally quiet with the finish of the season's orders. Dyeing reflected the position of the various textile branches and dyestuff orders were moderate. However, the events of the week-end have made the position last month quite valueless as a guide to the future, and at the moment of writing the general position is too vague even for speculation. The general intention appears to be to carry on where possible with existing orders at any rate for a few days until the outlook becomes less vague. Where there is room for making up depleted stocks or catching up with back orders it will generally be found that provision has been made for carrying on for a few weeks if the question of the supply of gas and electricity does not prove a stumbling block.

Dyestuff Licences for April

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 561, of which 519 were from merchants or importers. To these should be added 25 cases outstanding on the 31st March, making a total for the month of 586. These were dealt with as follows: Granted—517 (of which 476 were dealt with within 7 days of receipt). Referred to British makers of similar products—46 (of which 35 were dealt with within 7 days of receipt). Referred to Reparation supplies available—6 (all dealt with within 2 days of receipt). Outstanding on 30th April, 1926—17. Of the total of 586 applications received, 517 or 88 per cent. were dealt with within 7 days of receipt.

New Canadian Dye Company's Loss

THE annual report of the Dye and Chemical Co., of Canada, for the year ended December 31, shows an operating deficit of $9,602. Current assets are $23,139, and current liabilities, $55,885; but total assets are $15,400 in excess of liabilities. Dr. Atack, the President, states: "The building of our plant was commenced in October, 1924, and was practically completed in July, 1925. Due to large importations based on contracts covering 1925 requirements which had been placed before the company's products were on the market, your company was not able to go into full production on any of its lines until quite late in the year. It is expected that over 90 per cent. of the carbolic acid sold in Canada in 1926 will have been made in our works."

B.D.C. Stand at the Artificial Silk Exhibition

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Effects of the Strike

OUR market reports for the month indicate the serious effects that the coal stoppage, if it continues, is bound to have on the textile and on the dyeing and dyestuff manufacturing industries. The consumption of dyestuffs has already become seriously restricted, and this is bound to be reflected in the operations of the dyestuff factories. In some cases entire temporary cessation is suggested, though this, it is to be hoped, is much too pessimistic an estimate. The effects vary considerably in different parts of the country. The dyestuff industry in Scotland appears to have suffered less than in other parts, where the outlook is described as cheerless. Two features that offer some slight compensation are the fact that the actual conditions after so long a stoppage are not quite so bad as might have been thought and the hope that, with the end of the coal stoppage, business may quickly pick up again.

I.G. Movements

WE understand that, although there is no official announcement on the matter yet, the plans and *personnel* of the new company which is to be formed to sell and distribute the products of the I.G. Farbenindustrie in Great Britain have been practically settled, and that they agree in the main with the rumours current in the trade. The delegates from the Colour Users Association who have been on the Continent inquiring into the prices paid by users of dyestuffs there have completed their investigation. There is considerable speculation as to whether or not they found the prices such as to place the British consumer at a disadvantage. In view of the controversy on this subject it would seem only fair that the substance of the delegates' report should be made public.

Sir Alfred Mond's Resignation

IN view of the recent announcement that Sir Alfred Mond had accepted the chairmanship of Brunner, Mond and Co., in succession to Mr. Roscoe Brunner, no great surprise need be felt that he has felt obliged to retire from the board of directors of the British Dyestuffs Corporation, for the immense interests that the Brunner-Mond organisation now includes would leave but little margin for other duties. His retirement, none the less, will be much regretted at a stage of reconstruction and development when his exceptional experience and ability would have been of great advantage. Sir Alfred formerly sat on the board as one of the Government nominees, but later became an ordinary member of the board. He leaves the board and the Corporation in a much improved condition, as compared with the situation when he joined it, and can retire with the assurance that the B.D.C. is steadily emerging from its troubles.

New Colours

THE latest new colours announced by the British Dyestuffs Corporation are Victoria Blue R, Duranthrene Orange 4R Paste and Ionamine Blue B. Victoria Blue R, of which three very attractive samples are shown on mercerised cotton yarn, on woollen knitting yarn, and on tin-weighted silk yarn, is the latest addition to the B.D.C. range of basic dyestuffs, and is distinguished for the beauty and purity of its blue shades. On cotton, dyed on a tannin-antimony mordant in the usual way, it gives shades of good fastness to washing and acids. On wool, dyed from an acid dyebath, bright blue shades are produced of very good fastness to milling and stoving. On silk, dyed either from a weakly acid bath or in a boiled-off liquor with sulphuric acid, it gives brilliant blue shades of excellent fastness to water. Duranthrene Orange 4R Paste is suitable for dyeing all forms of cotton material. It finds its main use in the guarantee trade for the production of brown shades in combination with such colours as Duranthrene Yellow G Extra and Duranthrene Blue RD Extra. Ionamine Blue B is an addition to this series of colours for dyeing cellulose-acetate silk. It is a direct dyeing colour of very good fastness properties, especially to light and washing, being described as fully equal in these respects to the Duranol colours. It can be used for dyeing in combination with the other colours of the Ionamine series. It is said to possess certain advantages over Duranol Blue G in that it is a readily soluble powder product and therefore more convenient for handling and dyeing. The effect, as shown on Celanese knitted fabric, is extremely delicate, and it gives a brilliant appearance to Celanese yarn. Hickson and Partners, Ltd., have issued, in continuation of their series of cards dealing with Sulphur Blacks, card No. 4D, illustrating the use of Sulphur Black TB (powder).

Dyestuff Licences for May

ACCORDING to the monthly statement relating to applications for licences under the Dyestuffs Act, made during May, furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee, the total number of applications received during the month was 401, of which 369 were from merchants or importers. To these should be added 17 cases outstanding on April 30, making a total for the month of 418. These were dealt with as follows:—Granted, 370 (of which 357 were dealt with within seven days of receipt); referred to British makers of similar products, 39 (of which 28 were dealt with within seven days of receipt); referred to reparation supplies available, 4 (all dealt with within two days of receipt); outstanding on May 31, 1926, 5. Of the total of 418 applications received 389, or 91 per cent., were dealt with within seven days of receipt.

British Dyestuff Prices

THE question of the prices of British synthetic indigo and alizarine dyes, as compared with Belgian and German prices, was raised in the House of Commons on June 3. In reply to Mr. Duckworth, the President of the Board of Trade (Sir P. Cunliffe-Lister) said his information was that the present price for British synthetic indigo was 10d. per lb. for ordinary small quantities, with rebates bringing the price to 9d. per lb. for large quantities, and that the present price for German synthetic indigo was about 8½d. per lb. With regard to Alizarine Sky Blue, he believed that only the B brand was at present manufactured in the United Kingdom, and that the price quoted was 20s. 3d. a lb., and that the present German price was between 13s. and 14s. a lb. There was no Belgian production of any of these dyes.

Sir P. Cunliffe-Lister also stated that he had received no representations from commercial sources urging the need of the repeal of the Dyestuffs (Import Regulations) Act, except a resolution passed by the Council of the Blackburn and District Chamber of Commerce on December 9 last.

Lampose Developments at Strasbourg

ANOTHER notable event in the continued development of the artificial fibre industry, with which dyestuffs production is so closely bound up, was the formal opening on May 29 of the great works of the Soieries de Strasbourg at the Pont du Petit-Rhin. The Lampose group, with which the new factory is associated, is international in its scope and the ceremony was attended by many British, American, French, Italian, Japanese and other representatives. The first group of buildings has been erected on a site of about 15 hectares, up to recently occupied by agriculture, and obtained from the port and military authorities of the city. Three further blocks are to follow, so that Strasbourg, as the *Journal d'Alsace et de Lorraine* suggests, may presently approach in size the immense works erected by Courtaulds, Ltd., in America and England and those now in progress at Calais. The installation throughout is described as of the most modern character, and the plant, transport facilities, etc., are so planned that from the unloading of the raw material to the completion of the finished product the maximum of economy in time and labour is effected. Great attention, too, has been paid to the provision of hygienic conditions for the workers.

Dr. Bronnert's Enterprise

THIS enterprise is largely the result of the efforts of Dr. Bronnert, who has long been known as a research chemist in this field and has now demonstrated an equal gift for organisation on the industrial and commercial side. Dr. Bronnert is a native of Strasbourg and took his degrees at the university there. He collaborated for a time with Mr. Noelting-Schoen, director of the College of Industrial Chemistry, Mulhouse, and has for many years investigated processes for the production of artificial fibres. During the opening proceedings Mr. Kuntz, Chief of the Cabinet of the Préfet of the Bas-Rhin, said a few words in praise of the work of Dr. Bronnert in Strasbourg, following on his previous work in Mulhouse. He had, he said, insisted on perfect machinery and on production on a large scale, and he had organised carefully in order to cope with the almost crushing competition from countries with cheap labour. The Mayor of Strasbourg remarked that Dr. Bronnert, a son of Strasbourg, had always fought on the industrial and scientific fronts, and had returned to his native city to rebuild what he had lost during the war. He and his brother in England (Mr. Henry Bronnert, of Manchester) and the various friends working with them had brought great credit to the City of Strasbourg and to its industry. Mr. Muller, the Dean of the Faculty of Science, also paid a tribute to the scientific work of Dr. Bronnert, whom the university was proud of as one of her sons. After an inspection of the works at Pont du Rhin the guests attended a banquet at the Baeckehiesel, where, during the speeches, M. Marcel Braibant, the Conseiller-Général of the Ardennes, spoke of the services rendered in the reconstruction of his department by Mr. Henry Bronnert of Manchester, the brother of the Strasbourg inventor. Baron Albert de Dietrich added a similar tribute.

Sulphur Colours on Celanese Mixtures

IN a brochure (Celanese Dyeing Leaflet No. 7) recently issued under the above title by British Celanese, Ltd., information is given on the production of effects with sulphur colours on mixed goods of Celanese with cotton or other cellulosic fibres. There has recently been a great demand for fast-to-washing colours on such mixed goods where the Celanese is left white or alternatively tinted, the cotton, etc., being dyed to the main shade. It was not formerly considered feasible to apply sulphur colours where Celanese was present, since the sodium sulphide used for them had a deleterious effect on the Celanese fibre. By the extremely simple process described in the brochure this chemical is cut down to very small quantities, which, by the method given, are not dangerous. As in the case of direct cotton colours special individuals have to be chosen which have the property when applied by these processes, of leaving Celanese unstained. A list of the colours recommended and of their makers is given. It is worthy of note that British firms seem to be in a position to supply quite a large range of the colours, though foreign manufacturers figure largely in the list. When the Celanese (in addition to the other fibre) is also to be dyed, S.R.A. colours may be used, on account of their special fastness to washing.

Dyeing Methods Recommended

AFTER scouring at 75° C. in the normal way (using a scour containing per litre of soft water 2·5 g. of olive oil soap or good textile soap, 2·5 c.c. of Celascour, and 1 to 2 c.c. of 20 per cent. ammonia), and following this, if necessary, with a hypochlorite treatment, the goods are dyed in a bath of the following composition: 3 parts of sulphur dyestuff (100 per cent. powder), 2 parts of sodium sulphide (rock) or 4 parts of sodium sulphide crystals, 2 parts of sodium hydrosulphite and sufficient Celascour necessary to give a concentration in the dyebath 1 to 10 c.c. per litre. The colour is wetted out with a small proportion of Celascour and sufficient water and the sodium sulphide added. The temperature is raised to 85–90° C. and when all the sulphide has dissolved the sodium hydrosulphite is added. After stirring gently for 15 minutes or until the colour is dissolved, the whole is put into the dyebath (usually 12 or 15 : 1), which contains the balance of the Celascour. In dyeing the goods are entered at 50° C. and raised to 70° C. in 15 minutes. Dyeing is continued for three-quarters of an hour or to shade at this temperature, the material then lifted, rinsed in hot water and oxidised at 60° C. in a bath containing 2·5 grams per litre olive oil soap.

Salt may be employed in the dyebath in quantities up to 10 per cent. on weight of goods, but in certain cases it is liable to produce slight staining on the Celanese. The temperature of any wet treatment of Celanese should not exceed about 75° C., and therefore this temperature maximum should be carefully observed in scouring, dyeing, and other treatments. Strong alkalis should be avoided. Celascour, above-mentioned, is a new colloidal liquid preparation specially devised for use in scouring and dyeing goods containing Celanese yarns. Other scouring agents may affect the yarns deleteriously in regard to lustre and other valuable properties. When it is desired that the Celanese shall be tinted or dyed this is done, after the above treatment, with S.R.A. dyestuffs, of which a list is given.

Honour for French Dyestuffs Journal

THE French Société d'Encouragement pour l'Industrie Nationale has awarded a gold medal to the *Revue Générale des Matières Colorantes*, on the grounds of the great services rendered by the latter. The journal was founded by Léon Lefêvre in 1897, and in a report to the committee of the Society, M. Maurice Prudhomme says: "Struck by the inferiority in which his country found itself, L. Lefêvre gave himself body and soul to his production, and rendered most valuable services to the few French chemists who occupied themselves with the industry. The War showed, moreover, to those who did not know it, that explosives in general are derived from substances which are the basis of the manufacture of dyestuffs." After Lefêvre's death in 1916, the publication was carried on by his widow. The scientific and advisory committee includes Professor A. Wahl.

The Inter-relation of Light and Colour in Dyeing

A Review of Present Problems

During the course of the recent Optical Convention an important paper, entitled "Colour Problems in the Woollen and Worsted Industries," was read by S. G. Barker, Ph.D., D.I.C., and H. R. Hirst, B.Sc., F.I.C. (both of the British Research Association for the Woollen and Worsted Industries, Leeds). The paper, an account of which is published below, treats mainly of the establishment of colour standards and the measurement of light-fastness.

THE account by Barker and Hirst of "Colour Problems in the Woollen and Worsted Industries" deals with the results obtained by them in the laboratories of the research association, and also gives a general survey of the present position and the problems to be faced. "The paper," state the authors, "deals with two main subjects :—

"(1) The provision of a daylight lamp for the determination of the fastness or fugitiveness of dyes.

"(2) The method of fixation of definite standard specifications for shades and colours.

"Under the first heading a survey of the present position with reference to daylight fading lamps is given. The precise requirements for such a lamp are stated and the defects of the lamps available at present are discussed. A method of comparison of the energy distribution in the spectra of various sources of light is given. Results are incorporated showing comparisons of fading of dyes over a large range of shades and colours obtained by the authors in experiments with sunlight and the carbon arc. Further results of photometric measurements relating to sunlight fading are given. The present position regarding the chemical aspect of fading is surveyed fully. The problems of accurate colour and shade definition and measurement, the influence of water vapour, the effect of temperature variation, and the general influences of external conditions on fading are put forward as they affect the textile trade."

Light and Other Agents

The colour of a material is clearly of great æsthetic and commercial importance. Two points arise for consideration : the exact shade of the colour and the effect on it of external conditions. The external conditions may be chemical (such as the effect of alkalis, acids, perspiration, etc.) or physical (such as the effect of humidity, temperature, light, etc.). It is mainly in regard to the measurement of the physical actions that difficulties have arisen. Consider, for example, the effect of sunlight on dyed materials. This effect is well known, and if it is to be measured it is clearly necessary that the conditions under which the measurements are made should be comparable with one another. The problem really has two sides. In actual practice it is sunlight which causes change in the colour of dyed fabrics ; apparently, therefore, tests should be carried out in this light. But the nature and intensity of sunlight vary very considerably from time to time and from place to place. Moreover, its action is slow. For these reasons sunlight is useless as a source of light for comparative fading tests. This brings us to the second side of the problem, which is to find some standard source of light which, in the words of the authors, "should be reproducible and constant over long periods, both as to quality and quantity of light. It should produce the same changes in dyed material as would be effected by sunlight if the material were exposed in actual use."

Suggested Standard Daylights

If measurements are to yield the fullest possible information it is necessary that accurate knowledge should be available of the spectrum of the light used and of the distribution of energy over the various wavelengths. Various suggestions have been made as to the adoption of a "standard daylight" : one standard suggested is the radiation emitted by a black body at 5,000° absolute, while another is the average between blue sky light, sunlight, and light given by a black body of temperature 6,500°-7,000°. "If a standard could be fixed, the work of finding a suitable daylight lamp would be definite, for a close approximation to the same energy distribution would be aimed at." In this connection the authors give an account of a method which they have adopted for comparing the energy distribution of various sources of artificial light, which they are using for the examination of sources of light for artificial daylight fading experiments. Experiments already made by others showed that, for a certain artificial daylight lamp, as compared with sunlight, there was "an excess of energy at the extreme red (long wavelength) end of the spectrum and a deficiency in the extreme violet (short wavelength)."

"Further, experience has shown that these radiations beyond the visible spectrum are extremely powerful in effecting colour deterioration. Certain dyes, known as sensitive tints, show different shades when illuminated by light from different sources ; this phenomenon is due to strong absorption of the central portions of the visible spectrum and a consequent variation of shade and colour when there is variation at the extreme ends. It seems therefore that a source of light must be found which shall very closely reproduce daylight or sunlight without the use of filters, and then be corrected to a limited extent by filtration or reflection."

The spectra of various illuminants, including the violet carbon arc, have been examined with a view to finding how these light sources accord with requirements. "The last is certainly amongst the best obtainable for the purpose of fading tests, but our results show that they are really not a good criterion of what actually happens in sunlight under varying atmospheric conditions." The tungsten carbon arc, which is extremely rich in the ultra-violet, and the mercury vapour lamp have both been put forward as standard sources. Hermann concludes, as a result of his work, that "ultra-violet light from the mercury lamp is not a satisfactory substitute for daylight in fading tests." Further, the view is put forward that different wavelengths have different bleaching power.

Sunlight v. Flaming Arc

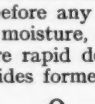
In view of the growing use of the flaming arc lamp as a substitute for daylight in fading tests, the authors have carried out a large number of experiments in which comparison was made of the effect of exposing worsted patterns dyed with typical dyes to sunlight and to the flaming arc, the daylight tests being for four periods of fourteen days and the arc tests for two periods of seventy hours, the latter being carried out at a temperature of 132° F. and relative humidity 75 per cent. As a result of these tests, which are incorporated in the paper in tabular form, it is stated that "the main thing to notice is that the electric arc fading does not place the dyes in order of fastness to sunlight. . . . In all cases the fabrics were dyed according to the normal instructions of the dye makers. The exposures to sunlight were made during July, August, and September, 1925. The average relative humidity of the atmosphere was 80·5 per cent. We have not yet had the opportunity of investigating personally the effect of variation of relative humidity of the atmosphere surrounding the patterns, but we give the results because they have been obtained in a manner generally adopted by the trade. The results are not satisfactory, and if such a method is generally used in its present state misleading conclusions will be obtained. Further investigation is necessary, and possibly some modification in the source of light and in the method adopted to control the humidity will have to be made."

Little work has been done on the effects of pure monochromatic light (*e.g.*, light of one particular wavelength). Clearly such work might give rise to results of very great value. Depierre and Clouet, in 1885, carried out an examination of the effect of different coloured lights on 76 colours dyed on calico. "They found that red rays had the least action, yellow rays exerted the strongest action on material dyed red or blue, and blue rays had the greatest effect on orange, yellow, green and violet. It was also found that white light had the greatest fading action, and that light complementary to the colour of the fabric had a great fading action, and that a coloured light essentially the same shade as that of the fabric had no effect."

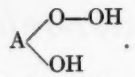
Manufacturers classify their colours in degrees of fastness. The authors have suggested a modified standard classification for general use. Sometimes curious phenomena may occur. From a knowledge of the fastness of two dyes separately it is not always possible to predict correctly the fastness of a mixture of the two. For example, picric acid and indigo carmine are both very fugitive ; yet a mixture of the two in certain proportions gave a fast result.

It should be observed that the effect of light on dyed materials varies with nature of the constituents of the air surrounding the materials. If the materials are exposed in evacuated glass tubes, or in tubes filled with inert gases, then (according to Chevreul and others) practically no fading occurs in sunlight. But hydrogen, nitrogen, oxygen and water all seem to react with dyed fibres in sunlight. "Brownlie states that an alkaline atmosphere increases the bleaching effect of sunlight on the dyed fibre system, whereas an acid atmosphere reduces the amount of fading. Alcohol and pyridine increase enormously the bleaching effect of sunlight. Chloroform or solvent naphtha slightly retard the fading, and some other organic solvents have no influence. The statement that alkali increases fading appears to be generally accepted, but this statement should be taken only as approximate. We have found exceptions to this rule and are investigating the matter more fully; it is, however, important that when patterns are tested, they should be either alkaline or acid, according to the conditions under which the material is to be used." Increasing humidity of the atmosphere seems to increase the rate of fading in sunlight. Increased rapidity of fading in sea air is due partly to this cause, partly to the presence of hydrogen peroxide and ozone, and partly also to the fact that much light is reflected from the surface of the water, thereby increasing the amount of light incident on the dyed material. The latter is probably the reason for the increased bleaching effect of light in snow-covered areas, especially as snow has great reflective powers towards ultra-violet light. In drying furs, "burning" occurs on exposure when snow is on the ground or in hot sunshine. "In all cases one must consider the effect, not of light alone, but of light plus air, and it would be preferable to speak of atmospheric fading rather than light fading."

The chemical reactions which occur during fading in sunlight have been the subject of much speculation. Gebhard is of opinion that oxygen acts on water, forming hydroxyl and perhydroxyl (OOH) ions, after which reaction with the dye occurs. It has been shown experimentally that in solution the greatest amount of fading occurs when the concentration of perhydroxyl ions is greatest. "In pure dry air, relatively stable peroxides are formed which show reactions for peroxides and not hydrogen peroxide before any colour change is visible; but on the admission of moisture, perhydroxides tend to be formed and there is more rapid destruction of colour. We have two types of peroxides formed:



a relatively stable form; and a labile highly reactive one, of the peroxide hydrate type,



The dye peroxides are formed during exposure to dry air, but peroxide hydrates result from the addition of perhydroxyl ions by the union of oxygen atoms with the ions of water." These conclusions of Gebhard have been criticised.

It seems probable that fading is a photochemical surface reaction. Catalytic effects must therefore play their part. For example, surface action depends on the amount of surface area. Cotton fibres are flat and ribbon-like, whilst wool fibres are elliptical—almost circular—in cross-section; and the difference may give rise to very different fading results when other conditions are the same.

"Grotthus stated that only those rays of light which are absorbed are effective in producing chemical change. The reduction of colour may be due to either oxidation or reduction. The formation of a dye is generally an exothermal process, whilst its decomposition is due to an endothermal reaction which is brought about by the application either of light or of electrical energy. The law of Ritter, Herschel and Becquerel states that rays of long wave-length exert an oxidising action, as opposed to the reducing action of rays of short wave-length. It thus appears that both types of reaction can occur and, arguing from the statement that absorbed rays only are effective, some relation might be established between the fading of certain colours (say red or blue) and their behaviour to oxidising and reducing agents. It is also known that when dyed patterns were exposed by Prof. Rutherford to positively charged helium atoms from radium emanation, cellulose was greatly damaged and many direct and basic colours and indigo were bleached, but little action was observed on indanthrene and para red."

Some absolute method of measuring the amount of fading must be found. For colour matching the tintometer seems to be the most practical British system. The authors conclude as follows: "The standardisation of the colours and shades of all dyes on some definite system is absolutely vital to the dyer, and a method of determining the exact amount of fading under various conditions so as to grade these dyes into order of fastness or fugitiveness is equally important to the textile trade. In conclusion, we would point out that dyeing is not only a science but an art. There are many unknown variable factors such as the selective affinity of wool fibres for dyes, etc., which have to be remembered and which are corrected directly by the experience and judgment of the operator. Yet scientific investigation is an absolute essential to the future progress of the dyer, and, in presenting the two problems stated at the beginning of our paper we put forward what we consider the most important of the questions to be answered before further work can proceed."

The Valuation and Detection of Dyestuffs

By C. M. Whittaker

The following notes on "The Valuation and Detection of Dyestuffs" are taken, by permission of the publishers, Baillière, Tindall and Cox, from the second edition, just published, of Mr. C. M. Whittaker's volume "Dyeing with Coal-Tar Dyestuffs" (pp. x, 248, 10s. 6d.).

THE valuation of dyestuffs is a much more difficult task than many people imagine, since by valuation is meant not merely money value tests of a dyestuff, but determination of its properties. The valuation of dyestuffs may be estimated by volumetric methods using reduction methods. Knecht and Hibbert have worked out a method using titanous chloride as a basis. Brown and Jordan (*J.S.D.C.*, 1923, p. 203) published a method of valuation of dyestuffs by titration. These methods are of value in special circumstances, but for dyehouse routine they cannot substitute dyetests.

Fastness to Light

The following are some of the usual tests through which a dyestuff is put:—

Light.—In carrying out tests for fastness to light regard must be had to the use to which the fabric on which the dyestuff is to be used is to be put. For instance, it is no use making a severe exposure of a direct cotton dyestuff which is going to be used for cotton linings, which will never be exposed to light. On the other hand, a dyestuff which is going into tweeds should have at least one month's exposure in the open in summer weather, without any protection. The author always exposes all mordant, acid, vat, and sulphur dyestuffs on a roof in the country facing south, without any protection whatever from rain, etc., but basic and direct cotton dyestuffs (unless known to be very fast) are always exposed under glass. As regards length of exposure, one month's unprotected exposure in the summer months is ample to show whether it is as fast as the standard chosen for comparison. If the cloth is for sailors' uniforms or for continuous and unusual exposure, then special precautions must be taken. Vat dyestuffs must be treated in a class by themselves: the fastest types of this class will withstand many months' exposure.

Heerman has published the following on the effect of the ultra-violet rays on dyestuffs: In the first place, there are dyestuff systems that will suffer destruction when exposed to light of very short wave-length. These are known as microtropic systems. Then there are those that are destroyed by the longer wave-lengths of light, which are called macrotropic systems. A prototype of this class of dyestuff is auramine, which holds up well against the rays of light from the ultra-violet lamp, but which is destroyed by ordinary sunlight. Then there are the systems that will decompose equally as well when exposed to long as to short wave-length light rays. These are known as homotropic systems. Finally there are those which are more affected by the longer wave-length rays than by the shorter ones. These systems are called mesotropic.

Milling, Scouring, and Washing

Milling.—The author's method consists of dyeing the dyestuff on some yarn and knitting it in a hand-knitting machine along with white wool, cotton, and silk, if necessary. This fabric is run through the rollers of a domestic wringing machine, which are driven from a shafting. Underneath the rollers is fitted a trough with an open steampipe in which soap and soda solution is put and heated to 100° F. (40° C.). Guiding bars are fitted in the trough so as to ensure that the fabric constantly passes through the soap liquor. Twelve years' experience of the machine has shown that a dyestuff which withstands the above test has never failed to stand in practical working.

Scouring.—The test should be carried out by steeping for six hours in soda ash solution 5° Tw. along with white wool, cotton and artificial silk, then washing off and drying. Some standard should be fixed upon, and this should always be done comparatively at the same time.

Washing.—The following method is very satisfactory. Make up a solution of 5 grs. soap and 3 grs. soda ash per 1000 c.c. of water. Use this solution at 100° F. (40° C.) for washing; rub the material, along with white wool, cotton, and silk, between the hands for 15 minutes, allow to lie in the soapsuds for 15 minutes, wash off, first in warm water to remove the soap, then in cold water, finally dry. Alkali is omitted if the test has not to be severe. Loss of depth, change of shade, and staining of white should be carefully noted as against standard.

Potting.—This is difficult to imitate in the small way, but the following method gives good comparative results, if a standard is always tested at the same time. Put a piece of the cloth to be tested between white flannel and cotton, wet them out thoroughly, then wrap them tightly round a glass rod and tie tightly round with string. Immerse the rod in water at the temperature at which the particular potting is carried out for the number of hours taken on the big scale. Note if the water is stained, also change of shade and staining of the white wool and cotton; silk is also taken if necessary.

Stoving.—This is a test which is best carried out under the actual conditions under which the dyestuff will be stoved in practice. Failing this, the following method gives good results. Stitch the dyed material between white wool and cotton, wet out thoroughly, then hang on a wooden stand, over which place a bell-jar, put an iron box containing sulphur under the bell-jar and ignite by dropping a red-hot iron bolt in it. Allow air into the jar until the smell of sulphur dioxide is pronounced outside the jar, put the jar down and put putty all round the bottom to keep the jar gas-tight. Leave like this for twelve hours, wash off, dry, then examine the pattern for change of shade and bleeding into the adjacent white.

Uses of Metal Vessels

Copper and Iron Vessels.—The use of copper and iron is increasingly common in dyeing owing to the steady adoption of dyeing machinery. All dyestuffs may not be dyed in copper or iron vessels without definite change of shade, so that it is requisite to test new dyestuffs from this point of view. This may easily be done by placing a coil of copper wire or piece of iron plate in the bottom of the dyepot whilst dyeing under exactly the same conditions another pattern without the metal in the dyepot. Monel metal is very largely used in the United States for dye vessels, and is now being widely adopted in Great Britain. Its effect on dyestuffs is practically nil, except when tannic compounds are used; it is to be expected that it will largely supplant the use of copper and iron in dyeing apparatus.

Hot Iron.—Many dyestuffs change their shade temporarily under heat, particularly direct cotton dyestuffs. This test is simply carried out by placing a piece of wet cotton cloth over half the pattern and ironing it dry with a hot iron.

Carbonising.—Soak the dyed wool half an hour along with the cotton in cold sulphuric acid, 7° Tw., then squeeze out. Now place in a porcelain dish and heat for one hour at 175° F. (80° C.), when the cotton should be completely carbonised. Wash off, neutralise with soda ash, wash off and dry.

Acids.—Spot with 10 per cent. D.O.V. solution for mineral acids and acetic acid (30 per cent.) for organic acids.

Perspiration.—Dissolve 100 grs. salt and 100 c.c. acetic acid (30 per cent.) in 1000 c.c. water; thoroughly wet out the pattern to be tested and a piece of white wool and cotton, roll together with the pattern between the wool and cotton, then incubate in a test-tube for 24 hours at 100° F. (40° C.). Examine for staining and loss of shade.

Alkali.—Dissolve 100 grs. salt and 10 grs. soda ash in 1000 c.c. water; treat exactly in the same way as for perspiration above.

The Identification of Dyestuffs

The following tests make no claim to completeness, but are among those used by the author in everyday routine work:

Basic Dyestuffs.—Boil a pattern with alcohol or methylated spirits, when the dyestuff will be dissolved off the fibre. Evaporate off the alcohol, redissolve the dyestuff in water in which tannin-mordanted cotton may be redyed the original shade. It is to be noted that basic dyestuffs do not strip off viscose easily.

Direct Cotton Dyestuffs.—Boil some of the pattern with ammonia and water, when the dyestuff will be largely stripped. Lift out the pattern, evaporate off most of the ammonia and add a little soap and water. Boil a piece of white cotton in this solution, when it will be dyed the shade of the original pattern. A developed dyestuff may bleed a little, but it will not dye the white cotton to the same extent.

Developed and Direct Cotton Dyestuffs.—These with some exceptions such as oxyphenine are permanently decolorised by boiling with tin crystals and spirits of salts, hydrosulphite, or titanous chloride. Basic dyestuffs and vat dyestuffs may be temporarily reduced, but they regain their shade on washing. Logwood black, catechu brown, aniline black, and sulphur dyestuffs are not completely decolorised. A developed primuline shade is reduced to the original yellow primuline bottom.

Sulphur Dyestuffs.—Boil in a test-tube with tin crystals and spirits of salts. Sulphuretted hydrogen will be evolved, which may be detected by placing a piece of filter paper, moistened with lead acetate solution, at the mouth of the test-tube.

Indigo.—Spot the material with concentrated nitric acid, when pure indigo gives a bright yellow spot with characteristic green rim. Many other dyestuffs will give a bright yellow spot but do not give the green rim characteristic of indigo. This test in the hands of an experienced operator is very good, but an inexperienced one may easily be deceived by shades which are faked up to give the indigo spot.

Mordant Dyestuffs.—These are distinguished by their fastness to boiling ammonia. Fuse some of the pattern with soda ash and sodium nitrate in a platinum crucible; dissolve out the mass, make acid with acetic acid and take care to boil the solution to drive off all carbon dioxide, add a solution of lead acetate, when a yellow precipitate of lead chromate proves the presence of chromium. Iron and copper may also be looked for.

Vat Dyestuffs.—Drop the pattern into warm alkaline hydrosulphite solution, when the characteristic colour of the leuco compound will be formed, which in most instances, except indanthrene blues, is quite distinct from the dye in its normal state. The original colour returns on washing off the pattern and exposing to the atmosphere.

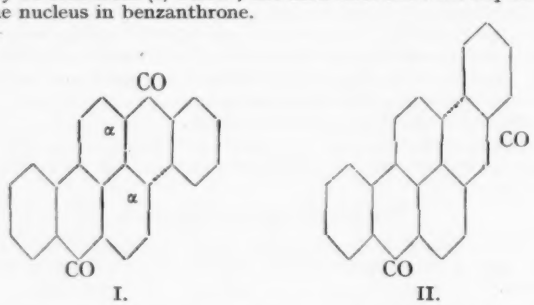
Dyes and their Application: Recent Technical Progress

By L. J. Hooley
(*Scottish Dyes, Ltd., Grangemouth*)

Benzanthrone and Perylene Derivatives

THE condensation of aromatic acid chlorides such as benzoyl chloride with naphthalene, or substances embodying naphthalene in their structure, is proving a fertile field for the synthesis of benzanthrones and similar condensed ketonic hydrocarbons. The technique of the method has been improved since it was introduced by Scholl, and larger yields are obtainable than previously.

Dibenzopyrenequinone has already been mentioned as synthesised in this manner. The principle of these syntheses may be seen from (I) below ; the dark lines show the naphthalene nucleus in benzanthrone.



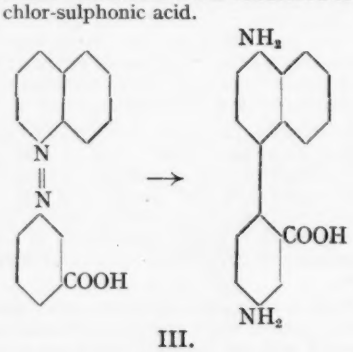
I. II.

This naphthalene has still two α-positions available and, on condensing with benzoyl chloride in the presence of aluminium chloride, junction is probably effected as shown, as the Bz.ring in benzanthrone is more reactive than the anthraquinone ring. On further treatment with aluminium chloride, the second stage of these syntheses, fusion in the peri position takes place as indicated by the dotted lines. This final body has also been prepared directly from naphthalene, the process above described taking place on both sides of the molecule. If, however, condensation takes place so that the benzoyl group attaches itself first to the anthraquinone, then an isomeric dibenzopyrenequinone (II) is formed.

When one of the α-positions is occupied as in the case of 2-chlor or 2-methyl benzanthrone, B.P. 222,125 (M.L.B), condensation must take place in a different way. The products are yellow vat dyestuffs of greener shade than dibenzopyrenequinone.

Tetra-benzoyl perylene is described in Fr.P. 591,271 (Pereira, Kuhlmann), by boiling perylene with excess of benzoyl chloride and aluminium chloride in carbon disulphide. Other aroyl derivatives of perylene are described by the same authors in Fr.P. 589,643, a blue vat dyestuff being obtained from dibrom-perylene with benzoyl chloride, and a brownish-violet with phthalic anhydride.

An interesting synthesis of diamino benzanthrone is given in U.S.P. 1,565,229 (G. Kalischer, R. Muller and F. Frister). Diazo benzene. *m*. carboxylic acid is condensed with naphthalene and reduced to the hydrazo derivative, which after undergoing the semidine transformation is condensed to the benzanthrone with chlor-sulphonic acid.

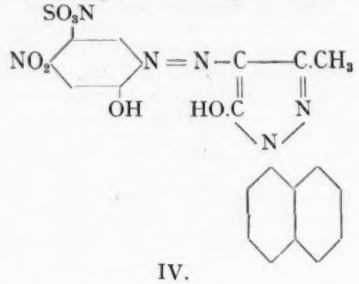


III.

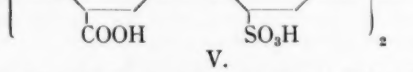
Various substituted perylene derivatives are described in Fr.P. 591,135 (Kalle and Co.). These are obtained by treating chlor, brom and nitro keto perylenes with the usual substances such as phenols, amines, etc.

Azo Colours

Pyrazolone derivatives, similar to Fast Light Yellow, but containing hydroxy groups in the *o*-position to the azo linkage so that the products are capable of being chromed, are obtained by combining 1-naphthyl-3-methyl-5-pyrazolone with diazotised 2-amino-4-nitro-1-hydroxy benzene-6-sulphonic or other similar sulphonated hydroxy amines (O. Kaltwasser, H. Kirchhoff and H. Oehrn), U.S.P. 1,556,329. The dyeings obtained with chrome give fast orange to bluish-red shades.



IV.



V.

Disazo dyes similar to the very fast to light Benzo and Chlorazol Fast Yellows, of the constitution V, are described in B.P. 245,674 (B.A.S.F.). The various stages in the synthesis may, as usual, be carried out in different orders. Other yellow pyrazolone dyes giving shades fast to light, washing, etc., are obtained from methyl pyrazolones or pyrazolone carboxylic acids by coupling with diazo compounds, such as sulphonic acids or oxy-carboxylic acids. In the case of the oxy-carboxylic acids the products may also be used as chrome colours, B.P. 245,765 (I.G. Farb. A.-G.).

Developing salts for azo colours are patented in G.P. 421,837 (B.A.S.F. and H. Krzikalli). These are made up from nitrites, amines, salts of mineral acids and other acids or indifferent substances, so that on dissolving in cold water diazotisation takes place and the product is ready for immediate use. Other stable diazo preparations in which the amine is already diazotised are given in Br.P. 246,870 (I.G. Farb. A.-G.), where the diazo compounds are mixed with partially dehydrated aluminium sulphate or alum.

The constitution of Hansa Yellow G (M.L.B.) has been elucidated by Dr. F. M. Rowe, A. H. Burr and S. G. Gorbishley. This is found by the authors to be best made by coupling diazotised *m*. nitro-*p*-toluidine with aceto-acetic ester, hydrolysing the ester, converting the resulting carboxylic acid to the chloride and then condensing with aniline. Monolite Yellow G (B.D.C.) was found to be identical with Hansa Yellow G (J. Soc. D.C., 1926, p. 82). The constitution of two further recent products of the Naphthol A.S. series, namely, AS/TR and AS/D, have also been determined by Dr. Rowe and Esther Levin, and are given in the same journal. Naphthol AS/TR is the 5-chlor-*o*-toluidide of β-hydroxy naphthoic acid. This Naphthol is used in conjunction with Fast Red TR base, which is found to be the hydrochloride of 5-chlor-2-amino toluene, and Fast Scarlet TR base, which is the corresponding 6-chlor derivative. Naphthol AS/D is the *o*-toluidide of β-hydroxy naphthoic acid and is used in combination with the same two bases.

Fastness to Light of Insoluble Azo Colours

German Patent 422,468 (Griesheim Elektron and B. Scheffer) claims the production of dyeings with improved fastness to light from insoluble azo colours containing certain arylides of 2.3-hydroxy naphthoic acid. The improvement consists in treating the dyeings under moderate pressure with weak solutions of metallic salts such as copper sulphate.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

June 10, 1926.

The general strike did not involve the textile workers to any serious extent, with the result that in the first week of May there was, in general, a tendency to buy much in excess of requirements. Such firms as were able to make immediate delivery by road probably have a fairly good average for the month. One heard of warehouse staffs working till midnight, and of consumers sending their own lorries to the various colour factories. In at least one instance, a London consumer despatched his private car to Manchester for one hundredweight of a product he needed; and, to complete the story, he was glad to add his bit to the general service by conveying two further hundredweights to London for other consumers. Altogether, the first few days were reminiscent of the early days of the Great War, when the man who could fill orders for dyestuffs cut a much greater figure than a mere buyer.

The boomlet soon collapsed, and from the first week to the end of the month there has been a quickly diminishing demand, culminating in almost no business during Whit week.

It is not possible to form any accurate judgment of the tendency of trade during the month. There is a belief that the Eastern inquiry for cotton goods is better, but delivery difficulties always tend to exaggerate the magnitude of trade inquiries, and it is necessary to discount reports to some extent.

The coal restrictions are now in full force, but this does not represent the full extent of the diminution of possible business, as it is reported that many dyestuff consumers have not sufficient coal even to enable them to run to the allotted 50 per cent.

It is understood that the dyestuff factories are considerably curtailing production, and in view of accumulated stocks, entire cessation is to be anticipated. Altogether the outlook is very cheerless.

It is reported that the delegates of the Colour Users' Association, who have recently investigated the prices paid for dyestuffs by our Continental neighbours, are back again, and some speculation is being aroused as to their report. It is to be hoped that full publicity will be given to the report even if, as many believe to be the case, it is found that the British consumer is under no disadvantage as regards price.

Although the plans and personnel of the new company, which is to sell the products of the I.G. in Great Britain, have been reported as settled, there is still no official announcement on the matter. It is, however, believed that the current public account of these is, in the main, accurate.

Yorkshire

June 9, 1926.

The shadow cast in April, which then disturbed progress in our industry, is succeeded by the coal stoppage, and thus once more is our trade seriously hampered. As these lines are being penned, it is felt that there is a distinct inclination on the part of the dyestuff consumers, especially the lesser ones, not to cope with the existing uncertainty, but with the diminishing of coal stocks to form plans for the closing down of their works. The state of mind is infectious, and is being felt by the colour manufacturer, who is undecided whether to incur the heavy overhead charges of an idle factory or to pay the increased prices demanded for surface and foreign coal with which to meet them. The phase was preceded by one of activity, for the consumer at the commencement showed some anxiety to ensure his supply of dyestuffs and chemicals, and during the general strike many transport risks were undertaken. It is reported that one day two lorries laden with casks and kegs of dyestuffs journeyed from a Yorkshire colour factory far into Lancashire, only to be there turned back by the none too peaceful persuasion of pickets to restore their full loads, intact, to their starting point.

Supplies of crude benzol from the coke ovens have ceased entirely, but there has been no tendency, so far, for prices to rise for stocks which are available. This is probably due to most of the material being sold on contract, which, of course, stabilises the price. A shortage of nitrobenzene is experienced, at which one does not wonder when a little thought is expended on the cost of manufacture and its comparison with its selling price. A result is a little more active interest in any existing stocks of benzidine. However, throughout these difficulties there has been no sign of attempts by makers to increase prices.

Most of the mills in Huddersfield closed down for the whole of Whitsuntide week, and hours of working now approximate to half time. Manufacturers showing in London for the next spring season report that they are disappointed by the comparative lack of interest being displayed. The continuance of the coal stoppage is naturally having an adverse effect on trade in the heavy woollen district, for which before the beginning of the trouble there were indications of a favourable prospect, especially in the demand from Canada.

Mr. George Bedforth presided over the annual meeting of the Yorkshire Dyeware and Chemical Co., Ltd., at Leeds. The report and accounts were adopted. A dividend was declared of 7½ per cent., making 10 per cent. for the year. A sum of £5,595 was carried forward to next year. Mr. George H. Clemens was elected to the directorate.

Midlands

June 10, 1926.

The general strike had a crippling influence on dyers in the Midlands. Most of the larger concerns are commission dyers, which means double carting on all goods. The effect of any breakdown in transport is, therefore, obvious.

Very little can be said about the outlook. Some dyers in the Nottingham area have work in hand, but the Leicester dyers say they have no coal and no work and are distinctly pessimistic.

Artificial silk hosiery, on which this district now so largely depends, is distinctly quiet, and nothing but a few special orders for odd dozens are being dyed. Cotton hosiery is equally flat. Sewing cotton is poor but better than most departments.

Woollen hosiery dyers can more than cope with orders in two or three days per week. Tanners have no orders. One of the largest leather merchants in the Midlands states that sales for May were 50 per cent. below April and that June promises to be even worse. There is scarcely sufficient movement in dyestuffs to test market values.

Directors of the German combine have visited the district with a view to fixing up offices and agents, but no definite appointments, it is understood, have yet been made.

Scotland

June 9, 1926.

Conditions in Scotland are not on the whole as bad as might have been predicted six weeks ago, if it had been then known that the coal stoppage was to last for this length of time. There have not been many cases of works closing down, either during or since the general strike. Most manufacturers were found to have been sufficiently circumspect to have laid in stocks to keep them going for a few weeks, and power supplies having been more or less sufficient, many firms have been running at something like usual rates. The relief following the abandonment of the general strike led to a modified optimism which has not yet entirely disappeared. Several individual firms report themselves as being fully occupied and even orders have in many cases not fallen as much below their general monthly level as was feared. This may in some part be due to a policy of getting in supplies while such were available, so that these have been bought beyond immediate requirements. Even where firms have not been so fortunate the opinion has been expressed that there is plenty of potential demand which will be released with a satisfactory settlement of the coal dispute.

Transport conditions in the industrial areas in Scotland during the general strike were more difficult than further south, and it was only possible for the more urgent orders to be got through, but this was the main disadvantage felt.

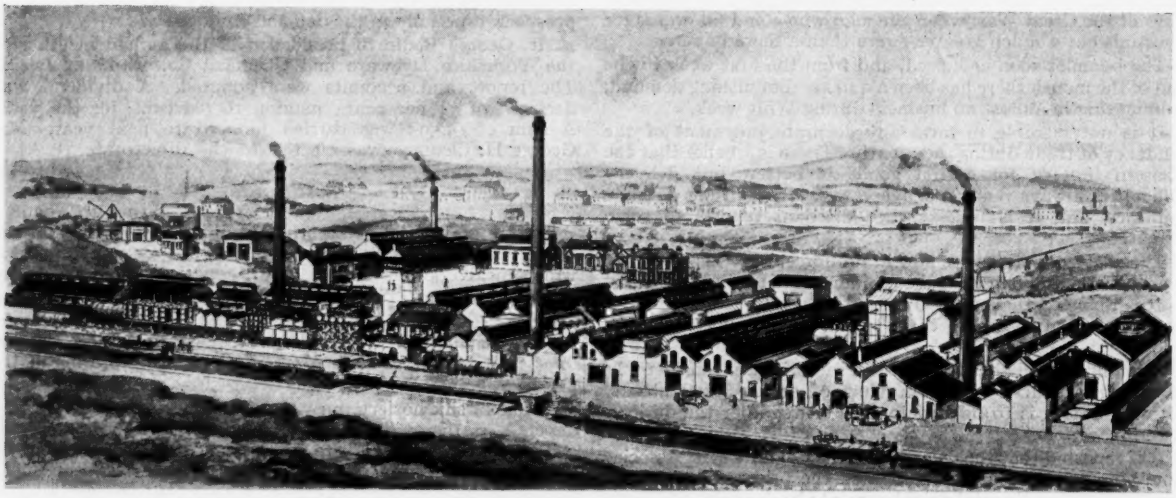
Around the Works: (5.)—John W. Leitch and Co., Ltd.

THE firm of John W. Leitch and Co., Ltd., of Milnsbridge, Huddersfield, was established in 1890 by the late Mr. John W. Leitch, B.Sc., for the manufacture of coal tar derivatives forming the basis for the preparation of aniline dyes and explosives. The present governing director is Mr. D. J. Leitch, son of the founder.

Commencing from the raw material, coke oven benzol, and being makers also of nitric acid and high concentration sulphuric acid, they manufactured an extensive range of nitro and amido derivatives of benzol, toluol and xylol, such as nitrobenzol, ortho- and paranitrotoluol, metatoluylenediamine, metaphenylenediamine, etc., etc. The quality and economic production of their products was such that they were able to export to all the foreign consuming countries, including Germany. They claim to be the first makers of T.N.T. in this country, having commenced the manufacture in 1902, and on the outbreak of the war were immediately able to commence deliveries of large quantities to the War Office, their production ultimately reaching between 70 and 100 tons per week. To-day, as in pre-war times, their special nitrobodies for explosives are well known throughout the world.

The works occupy an area of about 10 acres, and since the termination of the war the firm have concentrated their energies on the extension of their pre-war manufactures, having added to their range a considerable number of intermediates.

As a further extension of their activities, the firm have taken up the manufacture of various acid, basic, direct, paper, oil, pigment, lake and other colours. Particularly in the pigment and lake series, they have specialised in the production of colours of extreme fastness. They take a justifiable pride in their range of this class of colour, which includes various shades of yellow, orange, red, bordeaux and rubine.



The Dyestuffs "Who's Who"

5.—Dr. Herbert Levinstein

DR. HERBERT LEVINSTEIN was born at Prestwich, in 1878, and was educated at Rugby. He then went to Victoria University, Manchester, where he obtained his B.Sc. with first class honours, afterwards being awarded the Ph.D., *magna cum laude*, at the Polytechnic High School, Zurich. He then joined the firm of Levinstein, Ltd., at Blackley, near Manchester, which was founded in 1864 by his father, Mr. Ivan Levinstein, a past president of the Society of Chemical Industry, whose name is so closely associated with the reform of British patent laws. Dr. Levinstein became managing director of the firm, and on its amalgamation with British Dyes, Ltd., was appointed technical managing director of the newly founded British Dyestuffs Corporation.

During the war and after he was a member of the Chemical Warfare Committee, and in 1919 went with the Hartley mission to the occupied territory to investigate the production of toxic substances in the German dyestuff factories. He also acted as adviser to the British delegation at the Peace Conference on disarmament and reparation.

Dr. Levinstein is the author of numerous papers on chemical questions and has taken out a large number of patents dealing with dyes or their application, having discovered a considerable number of dyestuffs which have found application in industry. His firm during the war acquired the Ellesmere Port Works, formerly owned by Lucius and Brüning, synthetic indigo being manufactured at these works. He also acquired the works of Claus and Co., Ltd., at Clayton.

In addition to dyestuffs, mustard gas and flavin were manufactured at Blackley during the war. Mustard gas was also produced in large quantities in America, where the Levinstein Reactor was installed at the Edgewood Arsenal and generally adopted in the other American works. For supplying plans and methods for this purpose Dr. Levinstein received the thanks of the U.S.A. Expeditionary Force.

Dr. Levinstein has taken a prominent part in the leading chemical organisations, being honorary foreign secretary and a former vice-president of the Society of Chemical Industry, and past president of the British Association of Chemists. He is chairman of the Manchester section of the Institute of Chemistry, and president of the Manchester Literary and Philosophical Society. He is also a member of the Court of the Victoria University of Manchester.

Dr. Levinstein's activities are not limited to scientific and academic affairs, however, and he takes a keen interest in local matters, being the Didsbury Member of the Manchester City Council and a president of the Didsbury Agricultural Society. His recreation is sailing, and he is a member of the Royal Thames Yacht Club and of the Royal Mersey Yacht Club.

The China Clay Trade Review

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Canadian China Clay Discovery

A RECENT issue of the *Toronto Star* contains a highly optimistic report of a large tract of China Clay producing land in Northern Ontario, which is said to be the subject of "a deal that will involve millions." Interest in the subject is increased for China Clay producers on this side by the fact that Mr. Sydney Hancock, the engineer who has made a report on the property on behalf of the promoters, is the son of Mr. H. S. Hancock, well-known in China Clay circles at St. Austell. Mr. Hancock, in his report, states :—"It is reasonable to assume that there is a minimum of 40,000,000 tons on the 40 acres proved up, but as the bottom has never been reached there may be twice or three times that amount. Assuming an estimate of 30 per cent. of China Clay to be correct, we have from the first figures 12,000,000 tons of clay, or the whole world's consumption for 10 years, and 28,000,000 tons of silica sand, or the whole world's consumption for a much longer period. Vast as these figures are they touch only the fringe of the property. There still remains an additional 400 acres with 200 feet bore holes at the boundary still in the typical formation and nothing to indicate that there might be a change." In an interview Mr. Hancock confirmed his report that this deposit, if exploited properly, will completely dominate the world's China Clay market.

In considering Mr. Hancock's findings, it must be borne in mind that his various conclusions are admittedly estimates. If his sanguine expectations are anywhere near realised, the successful development of this reputedly large clay field would certainly prove a great menace to English China Clay business in America. English China Clay producers, while watching the progress of this new exploit with interest, are not unduly alarmed at the prospect predicted by Mr. Hancock, because there are certain natural obstacles to the successful development of China Clay deposits in Northern Ontario, two of the chief being transport and climatic conditions. The two predominant advantages that have favoured the English China Clay trade have been the ability to produce China Clay all the year round, and the nearness of the home China Clay deposits to the seaboard. For several months in the year operations would have to be suspended on account of the climatic conditions in Northern Ontario, and as Mr. Hancock's rosy estimates depend upon the property "being exploited properly," the natural disadvantages would seem to preclude the possibility of his estimates being fulfilled. In the meantime, China Clay producers of the West of England are hoping that, for the sake of their own industry, it will be a long time before the Northern Ontario clay fields "dominate the world's China Clay markets."

Successful China Clay Production

There has always to be borne in mind in considering the prospects of success of the development of any given area of clay its particular advantages compared with the advantages obtaining in the China Clay industry of the West of England. For instance, several years ago the discovery was made of beds of China Clay in Ireland, which were said to be of such productivity that their development would menace the industry of Cornwall and Devon. When the prospectors came to the practical side of the subject, they found that the locations of the deposits were so remote from railways and seaboard as to make their development in competition with West of England China Clays out of the question. Despite the suggestion made in an article by a correspondent in our last issue that "some of the older pits in the Mid-Cornwall area are becoming exhausted," it has been proved by geologists and others that there is very little prospect of the deposits, now being worked and under lease to existing firms, being exhausted at any rate for a hundred years. There are admittedly large tracts of as yet undeveloped China Clay deposits on Bodmin Moors and in North Cornwall as well as in Devon around Dartmoor. Neither of these areas, however, owing to such natural disadvantages as distance from railways and ports, can ever hope to be developed so cheaply or to offer China Clay on such favourable terms as can be made in Mid-Cornwall around St. Austell. Besides the natural advantage which the China Clay properties in the St. Austell area possess in railway facilities, especially at Fowey, where the latest apparatus for expeditious loading is a great boon to the industry, it must be borne in mind that existing works were opened up and established at a time when the capital outlay for the development of new areas was very small compared with the huge capital outlay that would be necessary to-day. In other words, it would require a clay of a very high quality and of exceptional productivity to be developed and marketed at a price that would compete with the clays that can be sold at a moderate price in the recognised areas of Cornwall.

Cornwall's Strong Position

The disadvantages attending the opening up of new areas in the West of England apply equally to the development of new China Clay deposits in foreign countries, where there would be the same transport difficulties, distance from seaboard, and high capitalisation to contend with. There would also be uncertainty as to whether the China Clay was of a quality to compare with the Cornish product. Moreover, it must never be overlooked that Cornwall has exceptional natural facilities in the profitable development of its white wealth on account of the location of the deposits in high ground, and the presence of ample supplies of waters. These factors permit of the works being operated by a method of gravitation, including the conveyance of the clay in liquid form from the works, where it is raised by pipe line to the drying kilns situated on railway sidings or alongside shipping ports. There is no doubt that the China Clay industry of the West of England, and especially in Mid-Cornwall, is, taking all things into consideration, in an exceptional position for producing and selling its commodity cheaply. No artificial means or methods adopted by China Clay producers elsewhere can ever hope to secure conditions on a scale comparable with those of the English China Clay industry to the extent of ousting English China Clays from their present markets.

China Clay Notes and News

Fowey Train Service Dissatisfaction

At the January meeting of Fowey Town Council a letter was received from the G.W.R. stating that instructions had been given to include Fowey on the company's pamphlets in future. Councillor Hambrook said that was far from satisfactory. It still took a long time to get from Par to Fowey for passengers on the 5.40 train from London and Plymouth in the morning. He thought the company could pay better attention to the connections from Par to Fowey. It was decided to write to the company on the matter.

Unexpected Uses of Clay

"The mode of life of early civilisation has been disclosed to us very largely through the imperishable clay products and records left after the destruction of all other forms of records in the intervening thousands of years," said Mr. E. Holden lecturing on "The Story of Clay" at the Technical School, Plymouth, recently. "Many of my audience," said the lecturer, "may have enjoyed some of the delectable and attractive table delicacies and popular sweetmeats which have in their composition some of the carefully washed kaolin recovered from the tors and crags of Cornwall, while even powder, so much in vogue at the moment, is 95 per cent. clay."

Canadian Kaolin Discovery

The following are details from American reports of the Canadian kaolin discovery referred to in our editorial notes: "A company is being organised with a capital of $7,500,000 for the development of kaolin, or China Clay, deposits situated at Kaolin City on the Mattagami River in Northern Ontario, and claimed to be one of the largest and most valuable of the kind known. The promoters of the enterprise are Mr. W. D. Sens, Hon. E. Bristol, of Toronto, and Mr. Charles M. McCarthy, of Elk Lake, Ont. The company will take over approximately 400 acres of the clay land which has been examined by Mr. Sydney Hancock, a Cornwall engineer, and it is proposed to erect a plant at Kaolin City capable of handling 500,000 tons yearly. The Ontario government will aid the enterprise by the extension of the Tinuskaning and Northern Ontario Railway for 32 miles from its present terminus to tap the clay deposit."

China Clay Merchant in Motor Accident

At the last sitting of St. Austell County Court, before Judge Gurdon, several hours were spent in hearing a case arising out of a motor collision which occurred in Bodmin Road, just outside St. Austell, on October 16, at about 9.30 a.m. Mr. Richard John Varcoe, China Clay merchant, of Tregarden, St. Austell, who was driving a car, sued John Lobb, China Clay works manager, of Roche, the owner of a car driven by a man named Allen, and claimed for £50 damages. Dr. Newcome Wright (Stephens, Graham Wright and Co.) was for the plaintiff, and Mr. J. C. Hubbard (Higman and Hubbard) for the defendant.

The evidence for the plaintiff was that he was passing a lorry when the defendant's car met him, and as he, plaintiff, was turning to his own side of the road, the defendant's driver turned in the same direction and caused the collision. The plaintiff's wife and two children were in the car, and they gave evidence. The defence was that the plaintiff was on his wrong side and did not attempt to give way to defendant until too late.

Judge Gurdon said plaintiff's solicitor had made a great deal of the point that if defendant had pulled up as soon as he saw Mr. Varcoe, the accident would not have happened, but when one driver was coming along on his wrong side of the road, as he held the plaintiff was, the man who was coming along on his proper side was entitled to expect that the first man would go on his proper side. A driver was entitled to expect a man on his wrong side to get over on to his proper side in time, and defendant was justified in believing that the plaintiff would turn. The accident occurred when the plaintiff was on his proper side of the road, but that did not matter as against the defendant, because the circumstances were brought about by the fault of the plaintiff in driving on his wrong side. He came to the conclusion that plaintiff was so upset at the time that he did not know what happened. He gave judgment for the defendant on the claim and counter-claim, with costs.

China Clay Official Attacked by Bird

Attending late one evening last week to the water supply feeding the turbines at the works at the head of the Luxulyan Valley, Cornwall, of English China Clays, Ltd., Mr. Albert Squires was attacked by a large bird, which, using both beak and talons, severely scratched his hands as he protected his head. Catching it by a wing, Mr. Squires threw the bird from him, but it renewed its attack, continuing it until it was knocked to the ground and killed.

The bird, which was found to be grey-backed and with a mottled-grey and white breast, measured 4 ft. 2 in. from one wing tip to the other, and is thought to be a species of buzzard.

Charlestown and Par Traffic

It is doubtful whether Charlestown and Par could deal with many thousands of tons more China Clay than they are now doing without increasing their accommodation and the facilities for quicker despatch such as mechanical apparatus for the loading of vessels. Extensive improvements in port facilities cannot be carried out without considerable expenditure which in these days of high taxation is not always available for such works. If there is an increased demand for the facilities offered by Charlestown and Par to work in their vicinities, the time may come for the authorities to take the question of extension into serious consideration. Meanwhile, it is gratifying to note that they are experiencing an increasing share of China Clay shipping consequent upon the growth in the demand for the commodity which the industry has recently been experiencing.

Knighthood for China Clay Merchant

Mr. Henry Montagu Rogers, J.P., of Nansloe, Helston, received a Knighthood in the New Year Honours List, for public and political services. The honour is given in recognition of the services rendered to his native county for half a century.

Sir Henry Montagu Rogers is a member of a well-known Cornish family and is one of the leading personalities in the Cornish tin and China Clay mining industry. He is chairman of the directors of East Pool and Agar Mines, Ltd., Tehidy Minerals, Ltd. (which owns extensive China Clay properties), Tolgus Mines, Ltd., and the Cornish Kaolin, and is a member of the Cornish Chamber of Mines. He took a prominent part in the revival of the industry following the depression, and his business ability and foresight, coupled with a long experience, have for many years proved a great asset to the industries in which he takes such practical interest.

A Keen Horseman

In former days he was a keen horseman and a successful exhibitor at shows. He took an active interest in re-starting the Four Barrow hounds after the war. For many years he has been one of the leading members of the Unionist party in Cornwall. Before the passing of the Redistribution Act he figured prominently in contests in the old Truro-Helston Division, and since the parish in which he resides was transferred to the Camborne Division, he has become a great asset to the party in that constituency. On the death of Mr. James Wickett, Mr. Rogers was elected president of the Camborne Divisional Unionist and Conservative Association—a position he has filled with distinction to himself and credit to the party. In 1924 he was elected President of the Royal Cornwall Agricultural Association, and acted in that capacity on the occasion of the memorable and successful visit of the show to Helston last year. A solicitor by profession, the new Knight was for a lengthy period clerk to Helston Borough Magistrates, retiring some time ago. In 1923 he was appointed a Justice of the Peace, and he sits on the West Kerrier Bench at Helston. He is a staunch Churchman.

A writer in the West of England Press, commenting on the honour, says: "We know enough to recognise that notice by the King through his advisers is well deserved. I like to think that the honour has come our way for other than political reasons. I would rather think that Mr. Rogers has been given his title because of the assistance he has rendered to the mining industry and of his social services in other directions. It was not so many years ago that hardly any agricultural show in the county was considered complete without Mr. 'Monty' Rogers."

Par Harbour Progress

At the end of the year, Colonel Edward Treffry, the owner of Par Harbour, who is also the Squire of Fowey, entertained 110 employees, with their wives, who are employed at Par Harbour and on Fowey Estate.

Mr. Robert Rundell, on behalf of the employees, tendered thanks to Colonel Treffry for his generosity which, he said, bore practical evidence of the good feeling which existed between master and men at Par Harbour, and he wished the Colonel the best of success in the New Year.

Colonel Treffry, in reply, welcomed the guests and expressed the hope that the new year would be a prosperous one for all of them through increased trade at Par Harbour. The present times were difficult for carrying on a business which depended upon so many outside influences over which they had no control. They had at times heard some wild talk against capital but they probably knew better than to listen to a lot of such vague remarks. What he and they were suffering from now was the lack of capital for the developments at Par Harbour which were required to maintain the present standard, and to improve and increase the facilities. They had seen that he had done his best to improve the channel during the past year. This had cost a good deal of money. Captain Carrivick, the Master of the Tug, confirmed Colonel Treffry's statement that the channel was now in as good a state as, or better than, it had been for very many years. Colonel Treffry said a lot more money could be spent in affecting improvements, but money which he would have been able to have spent at Par Harbour had to be diverted to meet the demands of the Government for the very heavy death duties he had now to pay, and it was obvious that if the Government took the money they had the spending of it, and he could not do as he wished, but that was the law and they all had to abide by it. He appreciated the friendly spirit in which they had met him, and hoped that the cordial relations, founded on mutual respect and esteem which had hitherto existed between his family and their employees, would always continue.

Inquest on Fowey Pilot

On Christmas Eve, while he was leaving the Dutch steamship s.s. *Peursum* which he had piloted into the jetty for a cargo of China Clay, the accommodation ladder slipped and Matthew Jacobs (50), a Fowey pilot well-known to China Clay shipping men using the port, fell into the water. He was rescued by boatmen, but his arm and back were injured, and pneumonia setting in, he died on the following Wednesday. An inquest was held on Friday, January 1, by Dr. E. S. Toogood, coroner for South-East Cornwall, who sat with a jury. The shipowners were represented by Mr. H. S. Turner.

W. C. Johns, junr., a boatman, said that he was in pilot Jacobs' motor boat, which was made fast to the rope ladder alongside s.s. *Peursum*. Jacobs called that he would be coming presently—meaning at once—witness looked up and saw Jacobs falling with the accommodation ladder. He caught hold of Jacobs, who was taken into another boat. Another pilot said he had seen pilot ladders in English boats fixed to the deck. It was the custom to use a deck ladder in order to gain the rope ladder.

The Captain of the steamship said it was not their custom to fix deck ladders at the foot, nor was it the custom in their boats for someone to be at the ladder to see the pilot off. The crew always used a ladder for leaving the boat. The ladder in question was made according to Dutch requirements.

A verdict of "Accidental death" was returned and the jury recommended that "the said ladder should in future be made secure in some way."

The Art of the Potter

Sir William Bragg's London Lecture

SIR WILLIAM BRAGG dealt with the "Trade of the Potter" on Thursday, January 7, in the fifth of his Christmas lectures to juvenile audiences, at the Royal Institution, London, on "Old Trades and New Knowledge."

He illustrated his lecture with lantern slides, and showed primitive potters treading the clay with their feet to remove all air bubbles—a method still used in Sheffield in making moulds for crucibles, as no machinery gives such perfect results. Later he showed a film demonstrating modern methods in the trade.

Sir William said that clay was the commonest of minerals and could be found in every country. In all parts of the world men had been potters and had made instruments of clay. The potter's clay was a wayward material, variable in its composition, and at times its behaviour seemed inexplicable. The worker therefore developed rules and traditions which were established by long practice rather than by understanding. One important question was "What was clay and what made it plastic?" The potter's thumb must make a perfect impress on the clay without being wetted or soiled. What did the test imply as to the essential nature of the clay?

Origin of China Clay

The general origin of clay was a question which was not yet answered in full; but certainly the fine China Clays, such as occurred in Cornwall, were derived from the weathering of the granite. The material was washed down with water, purified by sedimentation; partially dried and made into blocks convenient for handling. The fine bone china was made of China Clay, the so-called Cornish stone, and calcined bone. Earthenware was made of ball clay, China Clay, flint, and stone. The composite materials were ground to a definite fineness and "slopped up" with water; they were mixed and sieved, deprived of surplus water, and the substance was passed through what the lecturer described as a glorified sausage machine to form the "pug," a name which seemed to fit the material perfectly.

From this the pot was once formed on the potter's wheel or by hand; but now a casting process was more often employed, to which great scientific interest was attached. The clay was made alkaline in nature by the addition of suitable chemicals, and in consequence flowed as a liquid, though it contained far less water than would be required to bring it to that state without the alkali, thus making drying less dangerous. It was poured into moulds made of plaster of Paris. As it stood there the porous plaster drew the water out of the clay, and the stiffened material formed a coating within the mould.

When the deposit was sufficiently thick, the remaining "slip," as it was called, was poured away; and presently the clay had so far dried that the mould could be taken to pieces and the pot put carefully on the drying shelf. The drying presented many difficulties and interesting problems, for the clay shrank. In the subsequent fixing the shrinking was very great, and much skill was required to avoid cracking. In fact, the casting and fixing of such an object as a large earthenware bath was really a triumph of craftsmanship.

A Colloidal Substance

To return to the clay itself, the fundamental material of the potter, it would seem to be one more instance of a condition of things so common and so important that of recent years it had been specially studied under the name of "colloid chemistry." It was the condition in which one substance or one phase of a substance was dispersed in small drops or particles or fibres or flakes in another substance or another phase of the same substance. It existed in the dusty air, and in the fog, where particles of dust or water were held suspended in the air. It existed in a jelly, where interlacing fibres formed a spongy structure with a watery content. Foams and emulsions were examples of a different kind. The peculiar condition led to peculiar properties. The dispersed substance had relatively a very large surface compared with its volume, and its reactions might therefore be violent, or, again, it might remain long in suspension and coagulate, and be precipitated when the right reaction took place, as the mud of a river was precipitated when it met the salt sea.

Clay consisted of fine particles, some of them crystalline, dispersed in water; and so ranked with other instances named above. Moreover, each particle was surrounded by a jelly-like envelope of nature not well known; so that it could take up water and part with it again. These properties and conditions, said Sir William, must be exactly known before the nature of clay and its actions were understood.

U.S. Research in Clays

A Survey of Recent Investigations

A SPECIAL article in a recent issue of *Chemical and Metallurgical Engineering* summarises latest investigations of the U.S. Bureau of Standards and gives considerable attention to china clay problems.

Raw materials entering into various ceramic products comprise not only the cheapest unrefined surface clays that can be used in making common brick, says the writer, but in addition a large variety of carefully mined, selected and refined clays, often brought half way around the world to the point of consumption.

The potter in particular has a leaning towards foreign clays. This branch of the industry has always followed foreign, and especially English, precedent; hence the tendency to use foreign raw materials, and the Bureau's attempts to educate the industry in the qualities of American raw materials. In one piece of work the bonding effect of 7 American and 14 English ball clays were compared: (*a*) After burning, in a composition containing no fluxes, at cones 5, 8, 10, and 12; (*b*) in a semi-porcelain body burned to cone 8 and (*c*) in a vitreous china body burned to cone 11. The English clays developed greater strength in the absence of the fluxes. The semi-porcelain and vitreous china bodies containing the imported clays were in general of greater strength than those bodies in which the domestic clays were used, but most of the bodies containing American clays possessed good transverse strength.

Effect of Salts on Clay Suspensions

The aim of this study is: (*a*) To obtain physical-chemical constants for the preparation of specifications for clays for specific purposes, and also applicable in processes of their purification, and (*b*) the regulation of clay bodies for forming ceramic wares. The first phase of the study related to the *p*H of the solution phase of the clay-water system, as determined by the hydrogen electrode, and the effect on the rate of settling of three classes of clays. The results were published in Bureau of Standards *Technologic Paper* No. 234. Every commercial brand of clay, even when fairly uniform in superficial physical properties, and the relation of main chemical constituents, silica, alumina, ferric oxide, and combined water, varies widely in the relation of the proportions of the contained soluble electrolytes—the basic oxides. In order to study a clay synthetically and co-ordinate the basic character and composition with electrolytes and added colloids, and to make comparison with other clays of similar type, it is necessary to remove the original disturbing elements. This is being done by the natural process of leaching with distilled water containing carbon dioxide, as in the formation of gumbo clays. The material chosen for the study is a moderately plastic china clay that has been used widely by American potters and paper makers for over 30 years, with a reputation for uniformity. For comparison, a very pure residual kaolin with practically no plasticity, is being used.

The problem of a suitable technique, with different methods of attack and control of results, has led to the construction of a battery of horizontal leaching cells. The experiments have confirmed expectations, in that leaching has increased the volume of the slip 13 per cent.

Paper Clays

In connection with an investigation conducted by the Paper Section of the Bureau for the purpose of comparing American and foreign clays as paper fillers, a short study of the clays themselves was conducted for the purpose of determining what relation, if any, existed between the physical properties of the clay and its retention in paper. The essential requirements of clays for paper making are: Good white colour, low content of grit, mica, and other impurities; and uniformity. In addition to tests of these obviously necessary qualifications, further work was also done to determine the volume shrinkage water of plasticity, transverse strength, ratio of pore water to shrinkage water, the true specific gravity and the relative plasticity. Examinations were conducted on 38 samples, 18 of which were of foreign and 20 of domestic origin. It was found that domestic clays compare favourably with the foreign material as regards colour. Microscopic examination of residues from 8 typical clays showed these to consist principally of quartz and mica. The total residue on the 300-mesh screen varied from 0·34 to 1·40 per cent. The method used for comparing the plasticities is described in Bureau of Standards *Technologic Paper* No. 234. Of the eight clays examined, both the material of greatest plasticity and that of least plasticity were of American origin. Similar comparative tests, of the foreign and American materials, of the nature previously described, did not show any decided advantage of either clay, and no correlation was found between the physical properties of the clays as determined and their relative values when used as paper fillers.

Varying Effects of Drying

Practically all clay products must be dried before being placed in the kiln for burning. This is a considerable part of production cost, and may be increased considerably due to breakage of ware if drying conditions are improper. Clays differ considerably in the rate and time at which the water is given off, and consequently the amount of resultant shrinkage at any time. The determination of this feature alone, as well as the developing of economical drying under properly controlled humidity conditions, is a fundamental study now under way at the bureau.

The laboratory work of the first phase of this study, consisting in the determination of the effect of drying treatment on the strength and other properties of laboratory test specimens of different types in clays and commercial bodies, is nearing completion. Data have been obtained on the rate of moisture diffusion through clay, the rate of removal from the surface, and the rate of temperature rise within a body while being dried. The modulus of rupture has been determined on pieces retaining from 0 to 12 per cent. residual moisture at 110 deg. C. Although the increase in strength with reduction of moisture content varies in different clays, it has been found that the removal of the last 1 per cent. increases the dry strength from 50 to 100 per cent.

Printers and Coated Paper

Cheaper Dull-coated Product

THERE is much of interest for China Clay producers and paper makers in a recent discussion of printers' troubles with paper in America. Mention is made of difficulties in the handling of coated paper. By a number of modern developments the task of printing coated paper well, and printing it quickly, has been greatly simplified.

The first aid in this direction was the electric neutraliser. Not only did this make the handling and feeding of the paper much easier (particularly in winter), but it lessened the danger of off-set by removing the affinity of one sheet for another due to static electricity.

A device of still more recent development, which has almost revolutionised the printing of coated paper, is the gas-flame attachment on the extension delivery. The heat not only removes the last traces of static electricity, but it tends to dry the ink on the sheet as it is passing over the burners and leaves a cushion of warm air between the sheet just printed and the preceding sheet as the former drops between the joggers. The gas-flame attachment has practically rendered slip-sheeting on black and white printing a thing of the past. Incoming coated stock should be taken out of cases, stacked on platforms, and allowed to season in the pressroom, or in a room with atmosphere and temperature conditions similar to those of the pressroom, for a reasonable time before printing. It is also undesirable to print "green" paper—that is paper which has been coated just before it is used.

Coated paper, so far referred to, is of the type known as "high-coated." There is, however, now coming into the market an increasing quantity of various dull-coated papers. The first of these sheets to appear was very chalky, with a surface soluble in the slightest moisture. A finger-print left an indelible impression. The difficulty of handling was thus so great as to prohibit its use on any but small and special jobs. This type of paper has given place, however, to the sheets termed by the paper-makers as "semi-dull," and these are very much easier to handle.

The present difference in price between high-coated and semi-coated of a given grade is about two cents a pound. It is to be hoped that experience may reduce this difference still further, so as to permit the use of paper without shine on more quantity jobs.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—December, 1925

Sailings

Date.	Vessel.	Destination.
December 1	*J. M. Nielsen*	Granton
December 1	*Jane Banks*	Newcastle
December 2	*J. H. Barrow*	London
December 1	*Hilda*	Rochester
December 3	*Condor*	London
December 9	*Kindly Light*	London
December 11	*Amphitrite*	Nantes
December 14	*Gefion*	Leith
December 15	*Abercraig*	Leith
December 16	*Treleigh*	Preston
December 17	*Ribicia*	Le Pellice (France)
December 17	*Eulogia Mariatis*	Le Pellice
December 23	*Coaster*	Sunderland
December 29	*Nalan*	Brussels
December 31	*Neptun*	Leith
December 31	*Araok*	Nantes
December 31	*Lowland Firth*	London

Arrivals

Date.	Vessel.	From.
December 2	*Kindly Light*	Paignton
December 2	*Condor*	Salcombe
December 9	*Gefion*	Boulogne
December 12	*Abercraig*	Weymouth
December 12	*Ribicia*	St. Brieux
December 13	*Treleigh*	Barry
December 14	*Neptun*	San Lu
December 14	*Snowflake*	Runcorn
December 18	*Mary Barrow*	London
December 18	*Coaster*	Par
December 24	*Nalan*	Topsham
December 24	*Emily Warbrick*	Falmouth
December 25	*Lowland Firth*	Plymouth
December 26	*Araok*	Plymouth
December 26	*Kate*	Falmouth

Fowey Shipping—December, 1925

Arrived.	Name.	Sailed.	Destination.
December 1, S.S.	*Katharine*	December 1,	Plymouth
December 2, S.S.	*Horn*	December 4,	Rouen
December 2, S.S.	*Alice*	December 6,	Preston
December 2, S.S.	*Stertpoint*	December 6,	Runcorn
December 2, S.S.	*Joffre Rose*	December 4,	Bo'ness
December 2, S.S.	*Vechtstroom*	December 6,	Amsterdam
December 3, S.S.	*Rochdale*	December 15,	Portland, Me.
December 3, S.S.	*Freighter*	December 6,	Rochester
December 3, S.S.	*Simonside*	December 8,	Brussels
December 3, M.V.	*Pacific*	December 10,	London
December 3, S.V.	*Uku*	December 17,	Reval
December 4, S.V.	*Britannia*	December 17,	Copenhagen
December 4, S.S.	*Ville d'Etaples*	December 9,	Dunkirk
December 4, S.S.	*Ualan*	December 8,	Ridham
December 4, S.V.	*Gefion*	December 10,	Charlestown
December 4, S.S.	*Walnut*	December 7,	Charlestown
December 4, S.S.	*Ferndene*	December 10,	Antwerp
December 4, M.V.	*De Wadden*	December 13,	Par
December 6, M.V.	*Margrietha*	December 16,	Antwerp
December 6, S.S.	*Overton*	December 9,	Liverpool
December 6, S.S.	*Farfield*	December 9,	Plymouth
December 7, S.S.	*Treleigh*	December 9,	Newport
December 7, S.V.	*Jens Nielsen*	January 2, '26	Fredrikshald
December 8, S.V.	*Neptune*	December 14,	Mevagissey
December 9, M.V.	*Lydia Cardell*	December 13,	Rouen
December 9, S.S.	*Orchis*	December 15,	Ridham
December 9, S.V.	*Isabella*	December 10,	Par
December 10, S.S.	*Porthcorrock*	December 12,	Terneuzen
December 10, S.S.	*Southwell*	December 12,	Pasages
December 10, S.S.	*Maron*	December 15,	Drammen
December 11, S.S.	*Leaside*	December 17,	Drammen
December 11, S.V.	*Rose*	December 12,	Glasson Dock
December 11, S.S.	*Falmouth Castle*	December 15,	Runcorn
December 11, S.S.	*Haig Rose*	December 12,	Preston
December 11, S.S.	*Primrose*	December 14,	Runcorn
December 11, S.S.	*Boston Maru*	December 22,	Philadelphia
December 11, S.S.	*Blush Rose*	December 16,	Weston Point
December 12, S.S.	*Fernside*	December 16,	Kirkcaldy
December 12, S.S.	*Horn*	December 16,	Brussels
December 13, S.S.	*Ambleside*	December 18,	Antwerp
December 13, M.V.	*Kate*	December 15,	Pentewan
December 13, S.S.	*Loch Tay*	December 22,	San Francisco
December 14, S.S.	*H. Bauermeister*	December 17,	Barcelona
December 14, S.S.	*Dorset Coast*	December 18,	Birkenhead
December 15, S.S.	*Carterside*	December 19,	Sarpsburg
December 15, S.S.	*Brier Rose*	December 18,	Preston
December 16, S.S.	*Barflo*	December 19,	Brussels
December 16, M.V.	*Mayblossom*	December 23	Pentewan
December 16, S.S.	*Devonia*	*	Rochester
December 18, S.S.	*Gouwestroom*	December 23,	Amsterdam
December 20, S.S.	*Coaster*	December 21,	Par
December 20, S.S.	*Effie Gray*	December 23,	Grimsby
December 20, S.S.	*Westdale*	December 23,	Liverpool
December 20, S.S.	*Goodig*	December 24,	Burryport
December 20, M.V.	*Hope*	January 8, '26	Plymouth
December 20, S.V.	*Galathea*	January 1, '26	Charlestown
December 20, S.S.	*France Maru*	January 5, '26	Portland, Me.
December 20, S.S.	*Peursum*	January 5, '26	Boston, Mass.
December 20, S.S.	*Cervantes*	December 24,	Genoa
December 21, S.V.	*Rose*	December 23,	Par
December 23, S.V.	*Alice Williams*	*	Ardrossan
December 23, M.V.	*De Wadden*	*	Gravelines
December 25, S.S.	*Ferndene*	December 30,	Antwerp
December 27, M.V.	*Dragden*	January 2, '26	Naples
December 28, S.V.	*Mary Ann*	*	*
December 28, S.S.	*Gronant Rose*	December 31,	Preston
December 22, M.V.	*Theodora*	December 22,	Mevagissey
December 24, S.V.	*Araok*	December 26,	Charlestown
December 24, S.V.	*W. E. Gladstone*	*	*
December 24, S.S.	*Oak*	December 30,	Portland
December 26, S.S.	*Gunhild*	December 31,	Bo'ness
December 31, S.S.	*Brier Rose*	January 2, '26	Manchester

*Signifies " In Port."

Par Harbour Shipping—December, 1925

Arrivals

Date.	Vessel.	From.
December 2	S.V. *Lisa*	Charlestown
December 2	S.V. *Fanny Crossfield*	Dartmouth
December 3	S.S. *Tanny*	Avonmouth
December 3	S.V. *Lady Agnes*	London
December 3	S.V. *Falken*	Binic
December 10	S.V. *Isabella*	Fowey
December 13	S.S. *Seaforth*	Newport
December 13	S.S. *Robrix*	Truro
December 13	M.V. *De Wadden*	London
December 16	S.S. *Crossbill*	Plymouth
December 17	S.V. *S. F. Pearce*	Charlestown
December 18	S.S. *Towy*	St. Helens, I. of W.
December 21	S.S. *Coaster*	Pentewan
December 22	S.S. *Magrix*	Teignmouth
December 23	S.V. *Rose*	Fowey
December 26	S.S. *Glenbrook*	Goole

Sailings

Date.	Vessel.	Destination.
December 1	S.S. *Nancy Thomas*	Weston Point
December 2	S.V. *Henrietta*	Goole
December 9	S.V. *Hosianna*	London
December 9	S.S. *Tanny*	Penarth
December 11	S.V. *Lisa*	Leith
December 12	S.V. *Lady Agnes*	Poole
December 15	S.V. *Fanny Crossfield*	Ardrossan
December 15	S.V. *Isabella*	Queenboro'
December 16	S.V. *Falkan*	Fredrikshald
December 16	S.S. *Robrix*	Cravesend
December 18	S.S. *Seaforth*	Fleetwood
December 19	S.S. *Crossbil!*	London
December 19	S.S. *Towy*	Penarth
December 22	M.V. *De Wadden*	Gravelines
December 22	S.S. *Coaster*	Charlestown
December 24	S.S. *Magrix*	Gravesend

Par Harbour Tide Table

January, 1926

(Greenwich Mean Time Throughout.)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Saturday	16	6.47	7.11	13.10
Sunday	17	7.34	7.56	13.7
Monday	18	8.19	8.41	13.2
Tuesday	19	9.3	9.26	12.6
Wednesday	20	9.49	10.13	11.8
Thursday	21	10.39	11.7	10.11
Friday	22	11.38	—	10.4
Saturday	23	0.12	0.49	10.1
Sunday	24	1.27	2.5	10.3
Monday	25	2.40	3.13	10.8
Tuesday	26	3.44	4.12	11.2
Wednesday	27	4.36	4.58	11.7
Thursday	28	5.19	5.39	11.11
Friday	29	5.57	6.14	12.0
Saturday	30	6.31	6.47	12.3
Sunday	31	7.0	7.17	12.3
	February			
Monday	1	7.33	7.48	12.2
Tuesday	2	8.3	8.19	11.11
Wednesday	3	8.34	8.49	11.7
Thursday	4	9.5	9.23	11.3
Friday	5	9.43	10.5	10.9
Saturday	6	10.29	10.56	10.4
Sunday	7	11.27	—	9.11
Monday	8	0.3	0.43	10.0
Tuesday	9	1.25	2.7	10.7
Wednesday	10	2.47	3.24	11.7
Thursday	11	3.56	4.25	12.7
Friday	12	4.53	5.20	13.6
Saturday	13	5.46	6.11	13.9
Sunday	14	6.35	6.58	14.2
Monday	15	7.19	7.40	14.2
Tuesday	16	8.0	8.21	13.9
Wednesday	17	8.4	9.2	13.1
Thursday	18	9.22	9.41	12.1
Friday	19	10.1	10.24	11.0

E. CLEMENS, Harbour Master.

December Deliveries

Best Year since the War

THE December figures of trade done by China Clay firms bring the total volume for the year up to the 1912 record volume for the first time since the war. The total business done in terms of tonnage in the "boom" year of 1912 was 933,933 tons, often referred to as the million tons year. This year that total has been exceeded when the three classes —China Clay, china stone and ball clay—are taken into account, by over 24,000 tons, but as it is possible that ball clay tonnage was not included in the pre-war figures, the China Clay and china stone figures alone account for a tonnage of 930,573, a matter of 3,000 tons short of the 1912 total. The details of the tonnage are as follows :—

Port.	China Clay. 1925. Tons.	China Clay. 1924. Tons.	China Stone. 1925. Tons.	China Stone. 1924. Tons.	Ball Clay. 1925. Tons.	Ball Clay. 1924. Tons.	Total. 1925. Tons.	Total. 1924. Tons.
Fowey	56,579	52,239	2,074	2,442	2,811	3,083	61,464	57,764
Charlestown	4,662	4,627	—	—	—	—	4,662	4,627
Plymouth	1,617	2,100	10	6	—	—	1,627	2,106
Par	3,107	1,598	239	165	—	—	3,346	1,863
Penzance	—	370	—	—	—	—	—	370
Newham	—	189	—	—	—	—	—	189
Falmouth	240	—	—	—	—	—	240	—
By Rail	4,340	4,107	—	—	—	—	4,340	4,107
TOTALS	70,545	65,230	2,323	2,613	2,811	3,083	75,679	71,026
November	79,947	71,546	3,580	3,912	695	1,238	84,222	76,696
October	78,597	80,197	5,405	3,693	5,680	2,821	89,682	86,711
September	77,228	73,307	4,181	4,368	2,015	3,342	83,424	81,017
August	66,184	61,681	4,132	6,009	2,720	1,970	73,036	69,660
July	67,032	68,951	6,561	5,347	2,787	8,005	77,390	82,303
June	69,022	58,504	3,830	3,310	2,619	3,076	75,471	64,890
May	80,860	82,405	4,286	3,363	1,825	2,859	86,671	88,357
April	59,624	75,311	3,198	4,651	1,818	2,627	63,940	82,589
March	94,217	74,191	2,526	4,152	1,855	2,297	98,598	80,640
February	66,863	52,244	3,436	1,575	614	1,118	70,713	54,937
January	74,490	56,686	2,056	3,978	3,050	1,567	80,046	62,231
TOTAL, 12 months	930,573	820,253	45,964	46,971	45,789	33,733	959,372	901,057

China Clay Imports for December, 1925

A RETURN showing the registered imports of China Clay (including China Stone) into Great Britain and North rn Ireland from the several countries of consignment during the month of December, 1925, records two consignments, one to U.S. America, 2 tons, valued at £12, and one to Channel Islands, 275 tons, valued at £470, a total of 277 tons, valued at £482.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BOEKBINDER, LTD., London, S.E., fibrous plaster manufacturers, etc.—Reg. December 28, £5,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £4,000 ; general charge.

CAULDON MILL CO., LTD., Hanley, Potters.—Reg. December 15, mortgage covenant to surrender, etc., and debenture securing £5,000, to A. L. Walley, The Knoll, Regent Street, Stoke-on-Trent, flint merchant ; charged on Cauldon Mill and 63 and 65, Etruria Vale, Hanley, and general charge. *Nil. September 17, 1925.

CHAWLEY TIMBER, BRICK AND TILE WORKS, LTD., Cumnor.—Reg. December 23, £868 mortgage, to O. H. P. Turville-Petre, Bosworth Hall, Rugby, and another ; charged on properties at Cumnor, etc. *Nil. June 28, 1924.

REIGATE BRICK AND TILE CO., LTD.—Reg. December 19, two mortgages, to Westminster Bank, Ltd., securing all moneys due or to become due to the Bank ; charged on land formerly part of Highfields Estate, Redhill, and sand pit and land at Reigate.

RICHARDSON (A. G.) AND CO., LTD., Tunstall, earthenware manufacturers.—Reg. December 9, £300 mortgage, to Tunstall Goldenhill Kidsgrove and Talk o' th' Hill £50 Permanent Benefit Building Society ; charged on 4, Temple Street, Tunstall, and 9, George Street, Cobridge. *£15,000. October 25, 1924.

Satisfactions

FOURSTONES PAPER MILL CO., LTD.—Satisfaction registered December 17, £15,000, registered July 7, 1924.

GARWOOD AND MUDDIMAN, LTD., London, E.C., leather paper manufacturers.—Satisfaction registered December 18, £600, part of amount outstanding July 1, 1908.

China Clay Exports for December, 1925

A RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to countries of destination, registered during the month ended December 31, 1925 :

Country of Destination.	China Clay. Quantity. Tons.	China Clay. Value. £
FOREIGN.		
Finland	5	6
Esthonia	614	676
Latvia	665	949
Sweden	1,265	2,559
Norway	2,333	3,217
Denmark (including Faröe Islands)	277	525
Germany	2,172	4,921
Netherlands	3,960	7,927
Belgium	5,630	9,426
France	3,341	5,755
Switzerland	9	18
Spain	609	1,408
Italy (including Fiume)	3,534	7,788
Japan	—	2
United States of America	36,035	69,531
Chile	5	20
Brazil	7	39
BRITISH POSSESSIONS.		
Palestine	—	3
Cape of Good Hope	—	3
Bengal, Assam, Bihar and Orissa	595	2,394
Other Indian Ports	1,099	4,839
Australia	14	143
Canada	178	430
Total Foreign Countries and British Possessions	62,356	122,579

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

The China Clay Position Reviewed

As was shown by the statistics published in last month's supplement, the pre-war volume of trade was reached by the industry in 1925. Circumstances, well known to all engaged in the industry have, however, compelled China Clay firms to work on a narrow margin of profit, but they have resulted in China Clay being used to a larger extent and in more industries than previously. The industry's only hope of better prices lies in an even greater demand, which may eventually lessen the margin of over-production, if it does not eliminate it. While the growth in the volume of business done has its encouraging side from this point of view, it would be a mistake to suppose that financially the industry is in a flourishing condition, or that it is in a position to bear any additional production costs. The increased tonnage has had, and is having, a stimulating effect upon the employment position, not only in clay works employment but with firms engaged in transport, on the mineral lines, on the jetties at Fowey, in the cooperage trade, and at the local ports. All these allied industries are benefiting from the growth of trade, even though the direct advantage for the moment to the China Clay industry itself has not been so great as one would have liked. It is highly creditable to the industry that the producers have so well adapted themselves to the new conditions which were forced upon them in the autumn of 1924, and have set about so organising their works as to reduce production costs without reducing wages. Much as all interested in the welfare of the workers would like to see higher wages paid, the industry is as yet unfortunately unable to make any substantial increase in its wages bill, as is seen in the decision of the China Clay Employers' Federation not to accede to the application made by the representatives of the China Clay workers for increased rates.

Outside criticism has often been made of the industry that it has not devoted and does not devote sufficient attention to research and the investigation of means by which China Clay can be so refined as to make it suitable for use in a larger range of commodities. More scientific work is being undertaken by the industry than many people imagine. In the last few years, especially since the war, China Clay in a treated state has been introduced to a number of commodities in which it was not used before, at a price substantially higher than that of ordinary China Clay, and yet allows the manufacturer to use it with a considerable saving on the raw material previously used. Rubber is a case in point. With the soaring price of rubber, manufacturers are turning more than ever to other materials. China Clay has long since been proved to possess properties suitable for the purpose, without affecting to any material extent the resiliency of the finished article, or lessening its toughness or wearing qualities. Previously, with the price of raw rubber at a very low figure, there was little necessity for the use of substances to cheapen the rubber mixture, but now that manufacturers are hard put to it to counteract high prices, the use of larger quantities of China Clay should have a stimulating effect upon the demand for China Clay this year. China Clay producers are not blind to the potentialities of their product in this and other directions.

Canadian China Clay Deal

In our last issue we made reference to the bright claims made for what was reported to be a gigantic deal for the development of China Clay deposits in Northern Ontario, which, properly exploited, would, it was claimed, eventually dominate the world's markets for China Clay, We showed in our comments on the subject that there were certain difficulties in the successful exploitation of such deposits. These, compared with the exceptional natural advantages that favoured the production of English China Clays, would make it difficult for this new China Clay area—assuming the clay was of good quality and able to command a remunerative price — to compete with our home clays. These properties, which lie on the Mattagami River, some eight miles north of Smokey Falls, were optioned for several million dollars to Hon. Edmund Bristol, who, a local paper said, represented New York capital. It is understood that at the time of the proposed capitalisation some doubts were expressed locally as to the prospects of the venture and more recently there have been various reports as to progress. In some cases, we believe, there have been suggestions that the option to purchase has been abandoned. That these are hasty surmises may be gathered from an announcement in the *Toronto Star* of January 28, in the form of an interview with Mr. William Douglas, Senr., the owner of the deposits, who confirms the turning down of the option, but says that the enterprise is not dropped. "It is true," said Mr. Douglas, "that Mr. Bristol did not exercise his option, but this was not because of any lack of market for China Clay nor had it anything to do with the price at which we can sell it. You can say furthermore that Mr. Bristol dropped out of the deal within a week at my request." "At the time when Mr. Bristol entered into the deal," Mr. Douglas continued, "I was carrying on negotiations with both English and American capitalists who were interested in the property. Mr. Bristol came to me and said that if I would hold off a little he could make this an all-Canadian enterprise as he was in touch with capital which would be glad to come in. I am a strong advocate of keeping Canadian natural resources in control of Canadians, and accordingly consented to hold off as Mr. Bristol requested. I gave him a copy of the agreement and a letter covering it, which Mr. Bristol accepted verbally. The promised capital was not forthcoming and I called the deal off with him. The situation is that I am still negotiating with the original parties with whom I was in touch before I met Mr. Bristol. Teams are going in and the lumber is to be cut this winter for the erection of permanent buildings. The China Clay deposits are going to be opened and will be operated as soon as the railway is built." Home China Clay producers are more convinced than ever that it will be a long time before their business is menaced by competition from the China Clay deposits of Northern Ontario.

Fowey Harbour Regulations

Important Decision for China Clay Shippers

In the Admiralty Court early this month, Mr. Justice Bateson, sitting with two Trinity Masters, concluded the hearing of a case brought by Richard Hughes and Co., Liverpool shipowners, and several masters of their "Rose" boats against the Fowey Harbour Commissioners and Captain F. Collins, Harbour Master.

Plaintiffs complained that certain directions served upon them by Captain Collins dealing with the manner in which their ships should be handled in Fowey Harbour were invalid and they claimed an injunction to prevent the Commissioners or the Harbour Master enforcing them. The directions purported to have been made under section 52 of the Harbours, Docks and Piers Clauses Act, 1847, which section gives Harbour Masters power to make Regulations for controlling the movements of ships in harbours. Section 83 gives Commissioners power to make bye-laws for similar purposes. The regulations in this case limited the speed for proceeding up the harbour, prescribed an anchorage near the entrance for use at night, and limited the movement of ships above Penleath Point, where the harbour narrows considerably. It was intimated, however, that the regulations would not be enforced where a ship had a qualified pilot on board.

Pilotage is not compulsory in Fowey harbour for ships of the size owned by plaintiffs. Plaintiffs admitted that owing to a disagreement with the Trinity pilots at Fowey regarding the amount of pilotage fees, they had not employed pilots at Fowey since 1921, and claimed that these regulations were not made *bona fide*, but were made to compel them to employ pilots although their ships were exempt by law. They also claimed that the regulations were not those of the Harbour Master, but were made by the Commissioners or by their clerk, and that they were unworkable, unfair, and that they discriminated between plaintiffs and others and were not of a general character. If they were orders for all, they should be made by bye-law under Section 83 and not by regulation under Section 82.

Defendants' Case

Plaintiffs called several of their masters and two expert witnesses, and defendants relied on the evidence of the Harbour Master, Captain S. A. Buley, manager of the Fowey Tug and Salvage Co., Ltd., pilots Salt and Johns, their clerk, and two experts in navigation. Defendants' case was that owing to increased trade in China Clay in the harbour co-operation between the harbour authorities, the pilots, and the berthing master at the G.W.R. jetties was essential for the safe handling of traffic, that the pilots, as well as the Harbour Master, knew the movements of ships in the harbour. If a vessel chose to enter the harbour without a pilot she should, particularly at night, bring up in a place of safety until the necessary orders could reach those in charge of her, otherwise unnecessary risks were run which they contended had been the case on two or three occasions in which plaintiffs' ships had been in difficulty.

The hearing occupied nearly five days, and Mr. Justice Bateson held that the regulations were reasonable and valid, and he dismissed the plaintiffs' action with costs. Leave was granted for judgment to be stayed pending an appeal.

The Judge's Comments

In the course of judgment, his lordship said the plaintiffs asked for their declaration on the grounds that the directions were unreasonable, and, in fact, *ultra vires*. He had come to the conclusion upon the whole case that where the plaintiffs had the option either to follow the special direction or to take a pilot, where there was a further option to the vessel of either coming in at night or staying outside, or getting the sanction of the harbour master to proceed, it could not be said that such proposals were in any way unreasonable. If the vessel did not have a pilot, they must conform to the directions. The position taken up by the plaintiff owners seemed to him to be an exaggerated one.

The British Indian Tariff has been completely revised to take effect as from January 1, 1926. The item in the Import Section now appears as follows:—Serial No. 116, No. in the Statutory Schedule, 123, China Clay per ton, Tariff Valuation 85 R. *ad valorem*, Duty 15 per cent.

China Clay Workers' Wages Agitation

The Real Situation

Recently a somewhat alarming statement has been issued by officials of the China Clay workers' organisation, suggesting that a strike was imminent in consequence of the refusal of the China Clay Employers' Federation to grant an increase in wages. Such a state of feeling has not been exhibited on the part of the workers themselves.

The facts are that some time ago the China Clay employers were approached by representatives of the men to increase the wages by 2d. an hour, the rate at present being 1s. for day workers. The application was considered by the Employers' Federation, and they decided that the time was not opportune for considering an increase in wages, having regard to the severe competition prevailing in the industry and the necessity for keeping down production costs. This decision was conveyed to the Workers' Union representatives through the Joint Industrial Council. Following this decision, the China Clay workers' representatives requested that the matter be referred to arbitration, but this the Employers' Federation refused on the ground that they could not in any case entertain an increase of wages at present.

Since then the clay workers' representatives have asked for the matter to be reconsidered by the Employers' Federation, and a reply has been conveyed to the workers' officials that such a meeting will be held shortly to consider the workers' further communication.

With reference to the statement in the Press that a ballot of the men has been taken resulting in a vote of 8 to 1, suggesting that this decision was in favour of drastic action being taken if necessary by means of a strike, it is pointed out that this eight to one ballot vote was taken before the application was made for an increase of wages. Since the decision not to accede to the application for an increase in wages, or for referring the matter to arbitration, no ballot has been taken.

The relations between the China Clay workers and their employers are such as to preclude the likelihood of a strike to enforce demands which the industry is not in a position to concede.

Employer's Views on Wages Question

"A move by the Union Officials"

In reference to published statements emanating from Union officials as to the imminence of a strike in the China Clay district, an employer makes the following observations: "I must own that I was not only interested but very surprised, as it was the first intimation we have had that a strike was even contemplated. Of course, we were aware that an application was made for a rise in the clay workers' wages, but for various reasons this had been looked upon chiefly as a move by the Union officials. Further, we think there is very little discontent among the men. If the union could get a rise of 2d. per hour it would help their dwindling number of members, but many of the men in this area now look upon the union as a menace to their interests, and there are several reasons why a strike at the present time would not help the workers' union or the men.

"The union officials did not give reasons for a rise in wages, and evidently intentionally avoided stating the wages paid at the present time, probably because we are now paying a higher wage than for any other similar work in this district. The minimum now being paid is 1s. per hour, and then only a few men are paid at this rate. The majority earn much higher wages on piecework, and a good many receive higher hourly pay. Therefore your readers will now be able to judge for themselves on the merits of the union's claim for higher wages at 1s. 2d. per hour.

"Further, probably two-thirds of the clayworks are now working at a loss, and if the prices of the common and medium clays which these works produce are advanced, many of their markets would be lost to foreign clays at a cheaper price. There is also another point—a better day's work is necessary for higher pay—but I recently looked into a clay work and saw three men pushing a tram wagon, easy work for two-third-class men, but it used to be a one-man job only a few years ago."

China Clay Notes and News

Clay Courses at U.S. University

During January courses of clay working were held "to meet the requirements of practical men" at the Department of Ceramic Engineering, Illinois University, U.S.A. Eighteen lecturers contributed to the course, including experts in every branch of the clay industry.

English China Clay Director's Opportunity

The Hon. Montague B. Parker, of 31, Prince's Gardens, London, S.W.7, described as a director of English China Clays, Ltd., is reported to be a director of a new company—the Artificial Coal Company (Hamon Process), Ltd., for exploiting the by-products of peat at a factory to be erected in Norfolk at a cost of £100,000.

Gravel Pumps and China Clay

After a lecture at St. Austell on the "Internal Structure of Metal," Dr. J. W. Jenkin, B.Sc., Ph.D., an old St. Austell boy who is on the staff of the National Physical Laboratory, Teddington, was questioned by a local engineer with regard to a metal which would withstand sand under pressure. He said that in the China Clay gravel pumps they could not find a metal which would long withstand the wear and tear caused by the sand forced up. Dr. Jenkin said if steel would not stand the pressure he could not say what would. Dr. Jenkin left St. Austell next morning to resume work at the N.P.L.

Fowey Year's Shipping

The report of the Fowey Port Sanitary Authority Medical Officer of Health (Dr. W. H. King) for 1925 stated that the total number of ships using the port was 1,035, with a total tonnage of 381,727. The figures for 1924 compared as follows: Ships, 1,515; tonnage, 391,123. The number of ships inspected was 1,102, and 142 were found defective, chiefly in crew's dirty quarters and sanitary arrangements. In the majority of cases the defects were remedied, and in some cases the ships left before steps could be taken to correct matters. Seven notices were served. Five large steamers were paid off. No case of infectious disease had occurred during the year, and the isolation hospital was not opened.

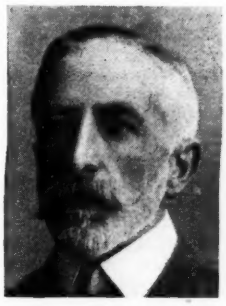
Central Cornwall Clay Company

In the Chancery Division on January 29, before Mr. Justice Lawrence, in the matter of Harold Benson for the holders of debentures created in January, 1922, and John Owen for the holders of debentures created in December, 1923, against the Central Cornwall China Clay Company, Ltd., Mr. Turner applied in respect of the appointment of Mr. Thomas Mills, of Swansea, as receiver and manager of the company, observing that interest for two half-years was in arrears and the capital had become due. Executions had been levied by creditors. The company was not represented. Its offices were at Fore Street, St. Blazey. The Judge said that the receiver would be appointed, giving him liberty to act as manager for three months, and if the parties agreed to take a final judgment he might act as manager until November 1 without further leave of the Judge.

China Clay Producers and St. Austell Territorials

The China Clay producers of St. Austell take a great deal of interest in the activities of the district, and they have recently, through the China Clay Producers, Ltd., presented the St. Austell Territorial Detachment with a silver presentation Cup, to be awarded for general efficiency. A letter sent by Mr. S. Benson on behalf of China Clay Producers, Ltd., to Dr. D. F. Hocken, commanding the St. Austell Detachment, states that the Board of Directors has purchased a silver presentation cup to be won for general efficiency, and it has been decided as a part of the gift that the winner of the cup will receive at his option either the sum of two guineas, or a replica of the cup, which will not cost more than the aforenamed sum, and same will be given each year by the China Clay Producers, Ltd., so long as this company is in existence. The cup will not be won outright. Lieut.-Colonel W. T. Lovering, on behalf of this company, will make the presentation of the cup to the winner. The company will insure the cup against theft and fire.

Sir H, Montagu Rogers



Last month we had the pleasure of announcing that a knighthood had been conferred on Mr. Henry Montagu Rogers, J.P., of Nansloe, Helston, for public and political services rendered to his native county for over half a century. We now reproduce a photograph of Sir H. M. Rogers, who is chairman of East Pool and Agar Mines, Ltd.; Tehidy Minerals, Ltd. (which has extensive China Clay interests); Tolgus Mines, Ltd.; and the Cornish Kaolin.

Clay District's Sobriety

At the annual St. Austell Brewster Sessions on February 3, Inspector Trythall, for Deputy-Chief Constable Banfield, submitted the annual licensing report, and stated that in the Division was a population of 26,993. There were 31 fully licensed houses, 2 off-licenses and 3 registered clubs, total 36. Four were six-day licenses. The average number of persons to each license was 710·13. During the year five persons had been proceeded against for drunkenness as compared with six last year. Since last year St. Austell Urban District had been enlarged, and in the urban district they had 11 fully licensed houses, 2 off-licenses, total 13, with an approximate population of 10,000, which gave an average of 666 to each license.

Move for New Association

All interested in the productive side of the China Clay industry will be pleased to learn that a new movement is on foot with a view to bringing all China Clay producers together for the formation of an Association to embrace all branches of the industry. Last summer some tentative steps were taken, but definite moves were postponed in consequence of so many firms having entered into contracts at certain prices for 1926. Whatever progress is now made with the formation of a new Association its operation cannot affect the control of prices and supplies for this year. The serious financial difficulties in which several of the China Clay companies have found themselves since the break-up of the old Association have proved the ruinous effects of non-control of the industry as a whole. Therefore little persuasion should be necessary to secure the favourable consideration by those that have survived the stringency of the last 18 months, of the proposals at present being made towards co-operative action without sacrificing the present individual operations of the producers. It is agreed that any arrangement must be on a basis of equality of treatment for all, whether large or small producers, any departure from a *pro rata* basis being certain to jeopardise the success of any scheme.

China Clay Merchant's Masonic Honour

There was a record attendance of Freemasons at the ceremony of installing Brother G. M. Johnson, Worshipful Master of Peace and Harmony Lodge, 496, at St. Austell last month, and the capacity of the Lodge to accommodate all who attended was severely taxed. In addition to brethren of Peace and Harmony, several other Lodges were represented. The Lodge was honoured by the presence of a visiting representative of Grand Lodge—Worshipful Brother George Rankin (Columbia), P.C.D.—as well as of W. Brother J. W. Higman, P.P.S.G.W., who is the oldest member of the Lodge with a record of over 50 years, and who was Worshipful Master 45 years ago, and W. Brother Robert Pease (Restormel), P.G.A.D.C., who has been Provincial Grand Secretary for 18 years. Another veteran Past Master of the Lodge who took part in the installation ceremony was W. Brother J. McTurk, who is the oldest member in point of age. The duty of installing as Master W. Brother G. M. Johnson fell to W. Brother W. H. Bettison, I.P.M., who carried through the work with its dignified ceremonial. He was assisted by W. Brothers Rankin, Higman, McTurk, Sleeman, and Bryan. W. Brother Johnson ably invested his officers.

At the close of the ceremony W. Brother Bettison was presented by the new Master with the Past Master's Jewel, high tributes being paid to W. Brother Bettison's year of office. Subsequently the company adjourned to the public rooms for the banquet. The W.M. presided over the gathering. The new Worshipful Master has been for many years associated with Varcoes China Clays, Ltd., the well-known China Clay and potters' merchants, of St. Austell and Stoke-on-Trent. He is a director of the firm, and frequently travels on its behalf. Mr. Johnson is a comparatively young man to achieve the distinction of W.M. of his mother Lodge, but he is thoroughly qualified for the position, both as regards his work for Freemasonry and as a man. Of a genial and charming disposition, the new W. Master has entered upon his year of office with the warmest congratulations of his brethren in the Lodge, in which are many representatives of the China Clay trade.

China Clay Merchanting Firm's Failure

Under a winding-up order made against Adolph, Wm., and Co., Ltd., 135, Upper Thames Street, E.C., exporters of China and Ball Clay, etc., on October 20, 1925, on the petition of J. Gimson and Co. (1919), Ltd., of Fenton, Staffs, the statutory meetings of the creditors and contributories were held at the offices of the Board of Trade, Carey Street, W.C., on January 14, when Mr. E. T. A. Phillips (Official Receiver) presided. A statement disclosed as regards creditors, ranking liabilities £16,453 and total assets £257. The assets, however, are absorbed by preferential and debenture claims. The paid-up capital was £6,302, and the estimated total deficiency is £22,755. The winding-up order was made on October 20, 1925. The company was incorporated on June 27, 1914, to take over the business of a general merchant which had been established since 1839. The nominal capital was £10,000. The business carried on had been mainly that of exporters to European countries of China and Ball Clay, colours, liquid gold, and chemicals. A substantial proportion of the company's trading consisted of transactions with customers in Russia, but the business practically ceased in 1917, and it finally came to an end when the Soviet Government came into power in 1919. Although the present Russian Government had agreed to recognise foreign debts, amounts owing by the company's former Russian customers, amounting to about £4,604, have so far proved irrecoverable. The failure of the company was attributed primarily to these and related causes. The liquidation remains in the hands of the official receiver. Creditors include J. Lovering and Co., China Clay producers, St. Austell, Cornwall, £824; Meeth North Devon Clay Co., Ltd., Ball Clay producers, St. Austell, £1,301; Perry Brothers, China Clay producers, St. Austell, £177.

"Research on Mineral Fillers"

To the Editor of THE CHEMICAL AGE.

SIR,—I have just noticed in THE CHEMICAL AGE, December 19, page 10, of the China Clay Section, an article, entitled: "Research on Mineral Fillers." This is apparently abstracted from the Bureau of Mines Technical Paper No. 296, entitled: "Size and Character of Grains of Non-metallic Mineral Fillers." Anyone reading this abstract would infer that the work had been done by the Bureau of Standards instead of the Bureau of Mines. The Bureau of Standards devised the method of air analysis, which is mentioned, and which was intended to apply to Portland cement, but the other references to the Bureau of Standards are in error.

Also in quoting Schone's formula, this is given as

"$D = 0{\cdot}0518 \frac{V\ 0{\cdot}636}{S-1}$" It should be $D = 0{\cdot}0518 \frac{V^{0{\cdot}636}}{S-1}$.

In other words, the quantity 0·636 is the exponent of V and not a factor of it.—Yours, etc.

W. M. WEIGEL, Mineral Technologist.

Bureau of Mines, Washington.
January 12, 1926.

Runners

By CHINA CLAY "CAPTAIN."

RUNNERS, especially at this time of the year, are not only topical but are indeed a very pressing question in many clay-pits.

A runner, in other words a slide or slip of natural clay, granite, stone or overburthen from the side of a clay-mine, is often a source of anxiety to the manager or captain in charge. For one thing, when the side begins to move, it is impossible to tell when or where it is going to stop. It seems to draw layer after layer of the strata, forming a vacuum, or its slipping, grinding action appears to form a solid barrier which causes the water to rise at the back and so press the mass forward.

One thing we know is that *water* is at the bottom or back of every runner. Sudden slips or runners at night are dangerous to life, and many fatal accidents have occurred through treacherous ground giving way unexpectedly. Although the men in charge have to inspect and sign a written report every working day, yet, with the greatest vigilance, unforeseen fatalities occur from time to time. It is during the winter rainy season, when the ground has become sodden, say, from Christmas to March, that runners are most frequent.

If one suspects a runner on any side of the pit which one does not want to go, the best thing is to drive a level to unwater it before the rainy season. If it shows signs where you intend to develop, take off the overburthen—and let it run. But it is not often a runner of clay only. I know a few "Cappens" connected with hard stony pits who would welcome a "runner of clay."

Danger to Work

When ground begins to run, it is very often just where you do not want it to move. Sometimes it rushes down, stops up the button-launder, and buries up the sand-pits. Or again, it "makes" towards the pumping-engine house, or the railway or a cottage, or it runs the dirty "burden" right down over the slope, polluting the clay and stopping all washing operations. A bad runner and "losing the lift" cause as much anxiety to those in charge as anything I know, for one seems so helpless in the case of a runner, because it flies off at a tangent, and it is impossible to stop it. It is too late to "drive a level" when it is on the move.

You may cut furze and drive stakes—cut leats and take off overburthen as fast as possible, yet while the rain falls it goes merrily on, and all interested are very glad when the winter gives place to spring.

Facilitating the Working of Troublesome Clays

THE working qualities of certain clays are sometimes difficult to contend with, necessitating the employment of agents to facilitate the increase or decrease of their plasticity. The capacity for absorbing water in different clays varies as greatly as their plasticity, some lending themselves readily to develop the necessary plasticity for moulding, whilst others easily crumble. Beneficial results are sometimes obtained by the wet grinding of certain clays which are troublesome to work with. During a number of experiments conducted on the effect of wet grinding on clays of low plasticity and strength, it was found that the dry strength of the clays was increased by wet grinding for two hours. A further increase in strength occurred with the addition of 1 per cent. of caustic soda or a similar amount of dextrin. The addition of the latter, and screening, increased the plasticity of the clays with wet grinding, but the employment of caustic soda made the clays tough, increasing the difficulty experienced in moulding.

The drying shrinkage of the clays and also their plasticity was increased, whilst the apparent density was reduced by wet grinding. This operation also increased the fineness of the grains of clay, a still greater fineness being effected by the addition of 1 per cent. of caustic soda. After burning to cone 2 the strength of the different clays under examination was increased when submitted to the foregoing treatment.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—January, 1926

Arrivals

Date.	Vessel.	From
January 1	*Galathea*	Wyborg
January 3	*Wansfell*	Plymouth
January 7	*Amphitrite*	Nantes
January 14	*Zebrina*	Exeter
January 14	*Dunmore*	Garston
January 14	*Flying Foam*	Goole
January 15	*Louise Ernest*	Par
January 15	*Isabelletta*	Falmouth
January 16	*Marena*	Cardiff
January 16	*Spurn Point*	Bridport
January 17	*Rivilen*	Guernsey
January 19	*Alsace*	Plymouth
January 21	*Lady Daphne*	Truro
January 26	*Pickmere*	Fowey
January 29	*System*	Alderney
January 30	*Nalan*	Cardiff

Sailings

Date.	Vessel.	Destination.
January 2	*Neptun*	Leith
January 4	*E. Warbrick*	Runcorn
January 4	*Kate*	London
January 4	*Wansfell*	Tayport
January 14	*Amphitrite*	Nantes
January 19	*Marena*	Barrow
January 20	*Galathea*	Granton
January 20	*Zebrina*	Terneuzen
January 20	*Dunmore*	Rochester
January 20	*Isabelletta*	Fleetwood
January 20	*Spurn Point*	Glasgow
January 22	*Rivilen*	Liverpool
January 25	*Alsace*	Nantes
January 29	*Pickmere*	Larne
January 31	*System*	London

Fowey Shipping—January, 1926

Arrived.	Name.	Sailed.	Destination.
January 1, S.S.	*Brilliant*	January 7,	Antwerp
January 2, S.S.	*Sweden Maru*	January 15,	Philadelphia
January 2, S.V.	*Mary Ann Mandall*	*	Goole
January 3, S.S.	*Scartho*	January 12,	Pasages
January 3, S.S.	*Ravenspoint*	January 7,	Genoa
January 3, S.S.	*Norman*	January 7,	Brussels
January 3, S.S.	*St. Brandon*	January 8,	Barrow
January 3, M.V.	*Gutharm Alsakar*	January 8,	Christiansand
January 3, S.S.	*Primrose*	January 7,	Runcorn
January 4, S.V.	*Emily Warbrick*	*	Runcorn
January 4, M.V.	*Annie*	January 8,	Plymouth
January 4, S.S.	*Pyrope*	January 6,	Rouen
January 5, M.V.	*Theodora*	January 6,	Mevagissey
January 5, S.S.	*Katharine*	January 8,	Plymouth
January 5, S.S.	*Albert Kassimir*	January 9,	Helsingfors
January 5, S.S.	*Allanwater*	January 9,	Liverpool
January 6, S.S.	*Seaforth*	January 11,	Runcorn
January 6, S.S.	*Fingal*	January 9,	Odense
January 6, S.S.	*Alice*	January 9,	Preston
January 6, S.S.	*Mountcharles*	January 9,	Lancaster
January 7, S.S.	*Wild Rose*	January 11,	Runcorn
January 7, M.V.	*Neptunus*	January 11,	Harburg
January 8, S.S.	*Gouwestroom*	January 13,	Amsterdam
January 8, S.S.	*Southwell*	January 12,	Pasages and Bilbao
January 8, S.S.	*Pansy*	January 12,	Leith
January 8, S.S.	*Farfield*	January 13,	Grimsby
January 8, S.S.	*Effie Gray*	January 12,	Antwerp
January 8, S.V.	*Rothersand*	January 14,	Charlestown
January 8, S.S.	*Svenske*	January 14,	Skien
January 9, S.S.	*Tritonia*	January 26,	Philadelphia
January 9, S.S.	*Condor*	January 14,	Rouen
January 11, M.V.	*Margot*	January 12,	Rhyl
January 11, S.S.	*Dorritt*	January 22,	Genoa
January 12, S.S.	*Deloraine*	January 15,	Pentewan
January 12, M.V.	*Petite Janine*	January 20,	Dunkirk
January 12, M.V.	*Ocean*	January 15,	Leith
January 13, M.V.	*Crown of Denmark*	January 16,	Exeter
January 13, S.S.	*Shoreham*	January 16,	Preston
January 13, S.S.	*Kenrix*	January 20,	Antwerp
January 14, S.S.	*Falmouth Castle*	January 15,	Runcorn
January 14, S.S.	*Guelder Rose*	January 19,	Aberdeen
January 14, S.S.	*Brier Rose*	January 19,	Hull
January 14, S.V.	*Carmenta*	*	Rochester
January 16, S.S.	*Westdale*	January 20,	Birkenhead
January 16, S.S.	*Stanwell*	January 20,	Glasgow
January 16, M.V.	*Harjumoa*	January 22,	Terneuzen
January 16, S.S.	*Horn*	January 26,	Brussels
January 17, S.S.	*Lord Londonderry*	January 29,	Portland, Me.
January 17, S.V.	*Richard*	*	Christiansand
January 17, S.V.	*Jane Banks*	*	Newcastle
January 17, S.S.	*Rosafred*	January 23,	Gothenburg
January 18, S.S.	*Adra*	*	Portland, Me.
January 18, S.S.	*Ferndene*	January 23,	Antwerp
January 18, S.S.	*Ualan*	January 19,	Cardiff
January 19, S.S.	*Tofuku Maru*	*	Philadelphia
January 19, S.S.	*Orenie*	January 23,	Rouen
January 19, S.S.	*Queenie*	January 26,	Garston
January 19, S.S.	*Stronsa Firth*	January 25,	Ridham
January 19, S.S.	*Claretta*	January 26,	Weston Point
January 19, M.V.	*Kurt*	January 29,	Bremen
January 19, M.V.	*Mayblossom*	January 21,	Pentewan
January 19, S.S.	*Rosalie*	January 27,	Greenwich
January 20, S.S.	*Wheatear*	January 23,	Bristol
January 21, M.V.	*Antigoon*	January 28,	Terneuzen
January 21, S.S.	*Coaster*	January 27,	Gravelines
January 21, S.S.	*Dorset Coast*	January 26,	Liverpool
January 21, S.S.	*Pickmere*	January 26,	Charlestown
January 21, S.S.	*Pylades*	February 2,	Bo'ness
January 22, S.S.	*Carterside*	*	Antwerp
January 23, S.S.	*Wild Rose*	*	Preston
January 24, S.S.	*Tiefsee*	February 2,	Antwerp
January 24, S.S.	*Blush Rose*	January 30,	Runcorn
January 24, S.S.	*Primrose*	January 29,	Weston Point
January 24, S.S.	*Kinne*	February 2,	Brussels
January 25, M.V.	*Laanemaa*	February 2,	Brussels
January 25, M.V.	*Wessex*	*	Pentewan
January 26, S.S.	*Washington Maru*	*	Boston and Philadelphia
January 26, S.S.	*Falmouth Castle*	February 2,	Runcorn
January 28, S.V.	*Waterwitch*	*	London
January 28, S.S.	*Mersey*	February 3,	Ridham
January 29, S.S.	*Florentino*	*	Genoa
January 29, S.V.	*Francis and Jane*	*	Weston Point
January 30, M.V.	*Theodora*	*	Mevagissey
January 31, S.S.	*System*	February 2,	Charlestown

* Signifies "In Port."

Par Harbour Shipping—January, 1926

Arrivals

Date.	Vessel.	From
January 1, S.S.	*Wearside*	Truro
January 4, S.V.	*Snowflake*	Charlestown
January 5, S.V.	*Allanwater*	Penzance
January 5, S.V.	*Mary Barrow*	Charlestown
January 12, S.V.	*Louise Ernest*	Plymouth
January 15, S.S.	*Treleigh*	Portreath
January 15, M.V.	*Moultonian*	Newport (I. o. W.)
January 18, M.V.	*Haldon*	Looe
January 18, S.S.	*Jolly Marie*	Rochester
January 21, S.S.	*Multistone*	Kingsbridge
January 21, S.S.	*Tynesider*	Exeter
January 21, S.S.	*Moorside*	Penryn
January 21, S.S.	*Trader*	Corselles
January 29, S.S.	*Robrix*	Hayle

Sailings

Date.	Vessel.	Destination.
January 2, S.S.	*Glenbrook*	Newcastle
January 5, S.S.	*Wearside*	Antwerp
January 5, S.V.	*Allanwater*	Fowey
January 12, S.V.	*Snowflake*	Runcorn
January 15, S.V.	*Rose*	London
January 15, S.V.	*C. F. Pearce*	Antwerp
January 15,	*Louise Ernest*	Charlestown
January 16, S.S.	*Treleigh*	Preston
January 16, M.V.	*Moultonian*	Plymouth
January 29, S.S.	*Jolly Marie*	London
January 29, S.S.	*Tynesider*	London
January 29, S.S.	*Moorside*	London
January 29, S.S.	*Trader*	London
January 29, S.S.	*Multistone*	London

Par Harbour Tide Table, March, 1926

(*Greenwich Mean Time Throughout*)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Monday	1	6.40	6.55	12.8
Tuesday	2	7.9	7.23	12.9
Wednesday	3	7.37	7.52	12.7
Thursday	4	8.7	8.22	12.4
Friday	5	8.38	8.54	11.10
Saturday	6	9.12	9.32	11.3
Sunday	7	9.55	10.22	10.7
Monday	8	10.53	11.28	10.0
Tuesday	9	—	0.11	9.0
Wednesday	10	0.58	1.45	10.4
Thursday	11	2.30	3.8	11.5
Friday	12	3.42	4.13	12.7
Saturday	13	4.41	5.6	13.6
Sunday	14	5.30	5.53	13.11
Monday	15	6.16	6.38	14.4
Tuesday	16	6.58	7.17	14.4
Wednesday	17	7.36	7.55	13.11
Thursday	18	8.14	8.32	13.2
Friday	19	8.49	9.7	12.2
Saturday	20	9.27	9.49	11.1
Sunday	21	10.14	10.42	10.0
Monday	22	11.15	11.55	9.3
Tuesday	23	—	0.39	9.0
Wednesday	24	1.25	2.9	9.6
Thursday	25	2.47	3.19	10.3
Friday	26	3.47	4.10	11.1
Saturday	27	4.30	4.49	11.10
Sunday	28	5.7	5.24	12.4
Monday	29	5.40	5.56	12.7
Tuesday	30	6.12	6.27	12.11
Wednesday	31	6.42	6.57	13.1

E. CLEMENS, *Harbour Master.*

China Clay Exports for January, 1926

A RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination registered during the month ended January 31, 1926.

Country of Destination.	China Clay. Quantity. Tons.	Value. £
Finland	1,117	1,117
Sweden	15	62
Norway	1,402	1,564
Denmark	446	1,166
Germany	1,457	3,954
Netherlands	4,212	9,008
Belgium	4,473	7,103
France	2,796	6,803
Spain	1,616	4,455
Italy	2,743	6,687
Greece	31	140
Roumania	6	31
China	5	27
United States of America	25,859	55,641
Mexico	45	176
Peru	10	45
Argentine Republic	100	382
Cape of Good Hope	—	1
Bombay via Other Ports	1,711	7,193
Madras	5	21
Bengal	410	1,158
Australia	57	290
Canada	15	69
Total	48,531	107,093

January Clay Deliveries Down

THE first month of the year for the China Clay industry does not disclose such an improvement in tonnage as was to be expected after the lull caused by the Christmas holidays, the total tonnage being nearly 3,000 tons down on December figures and nearly 9,000 tons below January, 1925. The detailed figures are as follows:—

Port.	China Clay. Tons. 1926	1925	China Stone. Tons. 1926	1925	Ball Clay. Tons. 1926	1925	Total. Tons. 1926	1925
Fowey	51,798	59,942	3,711	2,428	3,156	2,990	58,665	65,360
Charlestown	4,135	5,690	—	—	—	—	4,135	5,690
Par	3,285	3,231	31	43	—	—	3,316	3,274
Plymouth	2,948	1,445	—	35	—	60	2,948	1,540
Looe	194	84	—	—	—	—	194	84
By Rail	4,309	5,098	—	—	—	—	4,309	5,098
	65,669	75,490	3,742	2,506	3,156	3,050	72,567	81,046
December	—	70,545	—	2,323	—	2,811	—	75,679

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

CAULDON POTTERIES, LTD., Stoke-on-Trent.—Registered January 11, trust deed dated December 30, 1925, securing £250,000 1st debenture stock repayable at a premium of 2 per cent.; charged on properties at Stoke-on-Trent, etc., and certain shares and debentures, also general charge. *£150,000. January 14, 1925.

FOREST CHINA CLAY WORKS, LTD., London, E.C.—Registered January 28, £5,000 1st debenture, to F. W. L. Crespin, 15, Coopers Row, E.C., merchant; general charge. *£4,000. August 18, 1925.

SIMONS AND PICKARD, LTD., Nottingham, paper manufacturers.—Registered January 29, £1,000 2nd debenture, to T. Roberts, 14, Clumber Street, Nottingham, druggist; general charge. *£19,000 debentures. June 4, 1925.

WEST CARCLAZE CHINA CLAY CO., LTD., St. Austell.—Registered January 1, £3,000 debentures (filed under section 93 (3) of the Companies (Consolidation) Act 1908), present issue £1,800; charged on company's undertaking and all its leasehold properties and China Clay works whatsoever and wheresoever both present and future. *——. September 17, 1925.

WILLOW POTTERIES, LTD., Stoke-on-Trent.—Registered January 19, debenture, to bank; general charge.

Satisfactions

FOREST CHINA CLAY WORKS, LTD., London, E.C.—Satisfaction registered January 7, £4,000, balance of amount registered July 9, 1924.

MELTHAM SILICA FIRE BRICK CO., LTD.—Satisfaction registered January 7, £500, registered June 19, 1909, and £200, balance of £1,000, registered June 19, 1909.

Clays in Brickmaking

DR. HERBERT LEVINSTEIN in his presidential address to the Manchester Literary and Philosophical Society on January 26, recalled Biblical references to brickmaking in the book of Exodus and said that it might be deduced that it was standard practice in Egypt to use straw for making bricks; that the clay could not be used without straw; that prior to the use of straw this quality of clay was a waste material.

The discovery that if mixed with straw or with water in which straw had previously been rotted, or with the mixture of water and rotted straw, this clay became a good building material was surely one of great technical importance. Straw was not an obvious thing to use. They might be sure that many other binders or dispersing agents were tried before the method of using straw was finally adopted. It was well known to-day that part of the plasticity of Ball Clays was due to their contents of humus, though it would be difficult to say exactly what contribution to the total plasticity was made by the presence of this organic matter. Experiments had recently shown that the incorporation of specially rotted vegetation with China Clay had a marked effect on the plasticity. The latest method for briquetting fuel was by means of pulp binders prepared from rotting vegetable matter.

China Clay Imports for January

A RETURN of the registered imports of China Clay, including China Stone, into Great Britain and Northern Ireland during the month of January, 1926, shows only one consignment, from Germany, to the extent of 1 ton, valued at £7.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

Move Towards a New Association

ALL who are interested in the formation of a new organisation to further the prosperity of the China Clay industry will be glad to learn that such encouragement has been given to the project as to justify preliminary steps being taken by way of a meeting of all the producers. Last month a circular was addressed to producers inviting them to say whether or no they were willing to support a meeting called "to consider the present position of the industry and to take such steps as may then be agreed." Mr. John Charles Williams, the Lord Lieutenant of the County, had expressed his willingness to preside at such a meeting of the producers if it were made quite clear that the overwhelming majority of the China Clay producers desired such a meeting. In the course of the circular it was stated that Mr. Williams realised something of the consequences to the district of the long-continued and serious break in prices, and was now willing, under certain conditions, to convene such a meeting. This would be of a preliminary nature only and attendance would not commit anyone to more than a general readiness to consider the present position. It was not expected that any particular scheme would be then considered, but possibly a committee might be elected to deliberate on the matter and report to another full meeting to be arranged later on. The circular went on to say that if the wish of the China Clay producers was general and perfectly clear, it was suggested that they should invite Mr. Williams to act as Chairman of the meeting, which would in itself be a further indication that they all wanted to come to business.

There was a good response to the circular letter and the idea of a new Association is being very favourably entertained, both by those who are at present in the best clays Association, and by others outside. The members of China Clay Producers, Ltd. (the title under which the best clays producers' Association operates), while not taking any active part in initiating the present movement, would be favourably disposed towards a new Association. Their support would, however, be on the distinct understanding that all producers were agreeable to submit to the rules of the new Association and not to undermine its constitution by price-cutting, which practice eventually led to the break-up of the old Association.

Free Competition Prophecy Not Fulfilled

One of the arguments used by some of the firms who favoured the disbanding of the old Association was that by disbanding it and resuming free competition, the demand for China Clay would in a very short time be increased by 25 per cent. As a matter of fact, the increase that has been experienced does not represent more than 7 or 8 per cent., which cannot be ascribed wholly to the cheapening of the clays, because some of it has been due to natural increase in the demand, which was beginning to show itself before the Association broke up. Another remarkable fact that causes firms who are outside the best clays Association to reflect is that the bulk of the increased trade has been done by the firms within that Association, and it is a well-known fact that the members of that Association have been doing a great deal better from a financial point of view and are in a far stronger position financially than the bulk of the firms outside. This proves that far from benefiting from the free competition, which was given as a justification by some firms for breaking up the old Association, outside firms have suffered most by that free competition. There were two factors mainly responsible for trouble in the old Association. One was the increasing turnover of firms outside the Association by selling clays under price, and the other was the overselling of their quota by firms in the Association to the detriment of other firms who were not selling their quota. There was in consequence a reluctance on the part of the firms who oversold to contribute to the pool from which those who undersold could be compensated. The necessity for some such similar control of the industry will have to be considered in connection with the formation of a new Association. On the other hand, one of the chief justifications for a new Association is the problem of over-production. An essential to the success of any prospective organisation is that it shall be able to cope with this question and to ensure the equitable distribution of trade and profits. This important aspect of the problem is dealt with in more detail on another page. While there are undoubtedly many difficulties to be faced there is at least a sign of general desire for co-operation. This spirit is essential to success in any organisation, and we venture to think that the experience of the last eighteen months will not have been entirely without value. It will at least ensure careful consideration before any other break-away is contemplated.

The Meeting

The meeting of producers suggested in the circular was called by the Lord Lieutenant of Cornwall this week. (These notes were written before the event.) The meeting was described as a conference, and in the invitation to attend Mr. J. C. Williams wrote: "I have been asked to act as Chairman of the meeting at which the present position of the China Clay industry may be discussed by those concerned." No cut and dried proposals were to be laid before the meeting, the object being to ascertain the views of the producers on the suggestion for an organisation for the sales side of the industry, just as at present the industry has a Federation to watch the employment side and working conditions of the employees in the industry. This preliminary meeting has been more or less a feeler, and it will depend largely upon the attitude adopted by the producers whether any definite steps will be taken to prepare a formula for adoption later. It may be stated definitely that before the present best clays Association, as such, will give the movement its patronage, it must be assured that the producers are in real earnest, and that any organisation established shall receive practically the unanimous support of all firms and have in it indications of permanency. In asking this as a condition of their co-operation, it cannot be said that the best clays producers are asking too much, seeing that at the present time they are the members of a successful organisation. The result of the meeting is reported on another page.

When Mid-Cornwall Clays are Exhausted

Some Practical Facts and Figures

When, in our December issue, we published a correspondent's views on the necessity for looking ahead for other sources of China Clay, we understand that some readers were inclined to think such precautions unnecessary. Our correspondent now offers specific calculations upon the subject, and suggests that while the exhaustion of existing supplies is by no means imminent, the necessity for looking ahead would appear to be decidedly reasonable.

THE question of the rate at which the China Clay bearing lands of the Mid-Cornwall area are being worked out and the consequent necessity, in due time, of considering other known but undeveloped sources of China Clay supplies may not now appear to be one in which producers need be vitally interested. The following simple calculations, however, may bring home the facts to them more truly and convincingly than a general treatment.

One cubic foot of water weighs, say, 62 lb., and the specific gravity of China Clay is approximately 2·5. Therefore, 1 cu. ft. of China Clay weighs, say, 155 lb. On an average 5 cu. ft. of ground, including overburden, rock, etc., have to be moved for every cubic foot of China Clay dried. Thus, to obtain 155 lb. of China Clay, 5 cu. ft. of material must be moved. By a simple calculation it will be found that approximately 3 cu. yards of ground must be excavated for every ton of China Clay produced. On the basis of these assumptions, one acre one yard deep will yield about 1,610 tons of China Clay; one acre 50 yards deep will yield 80,500 tons, and 11 acres 50 yards deep, 885,500 tons, or about one year's production of China Clay.

One Year's Demands

The annual production of 885,500 tons of China Clay would necessitate the excavation of a pit 150 feet deep, with vertical sides, covering an area of 11 acres. Since China Clay pits for obvious reasons cannot have permanent perpendicular sides, a pit 150 ft. deep, from which 885,500 tons of China Clay has been produced, will have a surface area of at least double —viz., 22 acres. Thus, if the whole annual output of clay came from one pit it would exhaust an area of 22 acres 150 ft. deep as pits are at present worked; and, if the extent of that particular bed happened to be 22 acres, the pit would be exhausted in area, but might possibly be continued in depth to produce another, say, 400,000 tons, or half of one year's supply.

People who talk vaguely of inexhaustible supplies of China Clay and point to pits that have been working for a hundred years and are still being worked, overlook the fact that during the first 50 years the output from each of such pits was relatively small. As these pits were deepened and the quality of the clay thereby improved, the demand for the product of these pits resulted in intensive working, which can only lead to fairly rapid exhaustion, compared with the earlier rate of working.

The Need for New Supplies

An ordinary pit producing 20,000 tons per annum of China Clay is exhausting nearly 12½ acres, one yard deep, every year. Twelve and a half acres is quite a respectable area for a clay pit, and if its annual output exhausts one yard in depth every year then the pit is well within "anticipatory distance" of exhaustion. It is not suggested that the date of exhaustion is very near, but unless new areas are discovered and developed in Mid-Cornwall, the time will come when supplies will have to be obtained from elsewhere.

The Question of Economical Production

There is another point which is often overlooked by those who make ill-considered statements relating to the inexhaustible supplies of China Clay in particular areas. It may be true that a clay improves with the depth of working, but many of the so-called clay beds are deep troughs walled in by granite or other rock, and as the clay is removed the sides tend to fall into the pit unless an angle of repose is duly kept. In due course it becomes necessary for the owner of the pit to decide whether or no the clay obtainable from a great depth will pay for the removal of the tremendous amount of rock necessary to maintain the angle of repose, or, in other words, to keep the pit open. This fact should not be lost sight of when calculating the economic producing capacity of a pit. The fact that the clay is not exhausted in depth does not prove that the *pit* is not exhausted from an economic point of view. It is well known that the working of at least one old clay pit, once a prolific producer of best clay, has recently been stopped, and it is doubtful if it will ever be worked again for the reasons given above. There are other deep pits well within "anticipatory distance" of exhaustion.

In the more productive and intensely developed China Clay districts of Mid-Cornwall several of the pits are clustered together. These pits have been widened and deepened to such an extent that to-day two or more pits owned and worked by different companies have become one vast crater, with wire ropes suspended in mid air from side to side serving as boundaries between the different properties. This has happened in the Caudledown range of pits and elsewhere.

One Million Tons a Year

One million tons of China Clay cannot be mined year in, year out, without making serious inroads into the supplies at present being worked, and it is up to the far-sighted producers who wish to increase their output to look for new sources of supply for future generations, if not for themselves. It is doubtful if there is a single clay pit in existence which has produced during its whole history an amount equal to one year's total production of China Clay from Mid-Cornwall.

E. J. L.

"Canadian China Clay Discovery"

To the Editor of THE CHEMICAL AGE.

SIR,—In THE CHEMICAL AGE of January 16 I read an article on the China Clay discovery in Canada, commenting on the report made by Mr. Sydney Hancock, the son of Mr. H. S. Hancock, who you say is well known in China Clay circles at St. Austell. In the first paragraph you quote from Mr. Hancock's report and in the second paragraph you go on to show why his conclusions are wrong. You state that "if his expectations are anywhere near realised, the successful development of this reputedly large China Clay field would certainly prove a great menace to English China Clay business in America," but this is satisfactorily answered to your own mind, at least, by saying that certain natural obstacles to the successful development of the China Clay deposits in Northern Ontario are in the way, two of them being transport and climatic conditions.

You evidently have not taken the care or the trouble to make any inquiry as to these obstacles which you say loom up so largely. With reference to the first obstacle, that of transportation, it may be of interest to you to know that the building of a railway from Kapuskasing to within four miles of this deposit has already been begun and another will be begun, having the China Clay deposit for its goal, by the Provincial Government. The second obstacle, however, seems, according to your idea, to be still more formidable, and you make this astonishing statement:—"For several months in the year operations would have to be suspended on account of the climatic conditions in Northern Ontario, and as Mr. Hancock's rosy estimates depend upon the property being exploited properly, the natural disadvantages would seem to preclude the possibility of his estimates being fulfilled."

If you had taken the trouble to investigate this so-called obstacle, you would have found that there is nothing in that either, as the work can be carried on for twelve months in the year, day and night, if we choose. All the machines that are being installed are of the most up-to-date pattern for the washing of clay and the filtration of it.

It differs from the English China Clay pits in the fact that there is nothing in the deposit but China Clay of a high quality and a silica sand which has been determined by experts to be one of the finest grades of silica sand in the world, being 99·8 pure. Over the top of this whole deposit is a dense blanket of fire clay, and, if you turn to the report on Ceramics of 1918 of the Province of Ontario, you will see that it has

there been described by the late Joseph Keele as the finest No. 1 refractory fire clay he had ever seen.

You will, therefore, see from the above that your conclusions are wrong. This deposit is about 400 acres in extent, and once the slight over-burden of not more than five feet has been removed, every other portion of it is marketable, either as fire clay, China Clay, or silica sand. It is not necessary, as it is in some of the China Clay pits in England, to handle four or five tons of material to get one ton of China Clay, because the washing process from the silica sand is a very simple one and not one ounce of it is waste. It can all be sold at very attractive prices. The magnitude of this deposit may be to a certain extent determined by the fact that it has been drilled all over with a diamond drill to a depth of 362 ft. and the bottom has not even then been reached.

I am one of those who spent his money in the development of this deposit and in common fairness those two statements as to the obstacles should be removed. I enclose you a copy of Mr. Hancock's report for your perusal.—Yours, etc.,

Toronto, Canada. W. DOUGLAS.
February 13, 1926.

China Clay Producers Meeting Result

Investigation Committee Appointed

As we go to Press we learn that the meeting of China Clay producers held at St. Austell on Wednesday decided that the time is ripe for the formation of a new association to embrace the whole of the industry. The meeting appointed a committee to ascertain the views of the best clays Association and to report to a later meeting.

The Problem of Over-Production

Difficulty that Must Be Met by an Association

WHEN considering the whole question of a new Association of China Clay producers it must be borne in mind that the present demand for China Clay scarcely reaches one million tons per annum, and as there is an over-production of approximately 350,000 tons per annum, it must follow that no Association can produce conditions that will at once lead to markets being found for this surplus. Consequently, all firms producing China Clay, whether under an Association or not, cannot expect to dispose of their total production. Therefore the only fair way to deal with the trade available is to distribute it *pro rata* on a production basis. If there is to be no restriction of sales by firms who can sell over their quota, it follows that there will always be some firms who will not be able to sell up to their quota, consequently the latter must be provided for in some way. So far, the best system devised, and one that would have worked quite successfully under the old Association if all the producers had complied with it, was the pool system. Into the pool all firms who oversold paid a percentage of the value of their oversales, and from the pool firms who undersold were compensated, though not to the full extent of their undersales. If a better system can be suggested for dealing with this question of under- and oversales, it will be worthy of consideration when the producers come to grips with the proposals for a new Association, but this 350,000 tons per annum over-production cannot be overlooked.

It is this large over-production which is the justification for an Association in order to stabilise prices so that producers shall not be at the mercy of buyers who take advantage of this fact by pitting one producer's price against another's to such an extent as to make the production of China Clay less profitable than it ought to be. Producers must recognise that a new Association to be a success must be carried on on a *pro rata* basis, that all the members must be subject to the same regulations, and that no concession shall be made to some producers that cannot be made to all.

One essential to the movement for an Association is that practically every producer must be prepared to join, otherwise there will follow the same undercutting that led to the eventual break-up of the old Association. After the experience that many firms have had of the effects of free competition in an over-produced market, there should at any rate be a sufficient volume of favourable opinion to justify an attempt being made to secure agreement.

Research on American Kaolins

Attempts to Produce Substitute for British Clays

COMPARATIVE experiments between different American clays and English China Clay have been conducted with a view to producing an equivalent to the latter from American material. Several American kaolins were elutriated, using for the purpose an apparatus resembling the Schulze type, with a series of four cans, conically shaped in the under parts and cylindrically above. The speed used for separating the silt and clay, and for dividing the latter into three grades, was similar to that specified by Seger. This was attained by correspondingly adjusting the diameter of the cans and the velocity with which the liquid travelled through them. After the clay had been sufficiently crushed to pass entirely through a number four sieve, it was thoroughly blunged and sifted. When the slip had passed through a 200-mesh sieve it was deflocculated by the addition of a small proportion of caustic soda and introduced drop after drop into the elutriator. Not until the whole of the slip had been admitted in this way was the ratio of the flow permitted to increase beyond two-thirds of the maximum velocity. In order to prevent flocculation whilst the caustic soda was washed out of the clay, a small amount of dilute ammonia was added from time to time to the water as it travelled through the elutriator. Some kaolins tested in this manner resembled English China Clay in that they contained a large percentage of minute particles below 0·010 mm. diameter, whilst in others the percentage was extremely low. It was considered that, for some purposes, Delaware kaolin, with proper treatment, could more suitably replace English China Clay than others under examination.

China Clay Wages Question

Union Branches Said to be Moving

THE China Clay Employers' Federation held a meeting at St. Austell on February 24 to consider the following resolution passed by the employees' side of the Joint Standing Industrial Council of the industry, arising out of the recent decision not to grant the request to the Workers' Union representatives for an increase of 2d. per hour :—" That the Federation be asked to supply this Council with the selling prices of the different grades and information that will enable us to understand the reason for refusing the application."

The gist of this resolution had already been communicated to the Press. The Federation was unable to comply with the request made in the resolution. The Federation had reported their decision to the Joint Industrial Council of the industry.

Branch meetings of the Workers' Union have since been held to consider the action to be taken on the employers' refusal to accede to the application for an increase in wages. It is stated that the feeling expressed at the meetings so far held has been in favour of strike action. When the resolutions of all the branch meetings are received, the next step is for the district meeting, representative of the branches, to decide what further action shall be taken.

The position from the employers' point of view is that they have turned down the men's application on the grounds that the industry cannot stand an increase in wages costs at the present time. They have further declined an application by the employees' side of the Joint Industrial Council to give the prices at which clays are being sold. We understand that the employers' reasons for refusing this request is that they are not in a position to give these prices because the prices at which the individual firms sell their clays are not known to the Federation.

There is a strong feeling among the more moderate elements of the workers that before any extreme action is taken the intervention of the Ministry of Labour should be sought. Colonel Josiah Wedgwood at a recent meeting at St. Austell replied to a question by Mr. Clemens, district organiser, and said that the Ministry of Labour could intervene before a dispute developed into a strike.

It is stated that the workers' representatives are pressing for a decision in their favour on the ground that when the men were asked to submit to a decrease during the slump they were promised to have their wages restored when trade became normal. On the other hand, the employers contend that if the volume of trade has become normal, prices have not, and that the industry is far from being in a normal condition financially, and is not in a position to pay more wages.

Mechanical Handling of China Clay

Modern Plant in Use

In these days of keen competition the economics of mechanical handling are of interest to producers and users alike. Herbert Morris, Ltd., Loughborough, specialise in the production of mechanical handling plant to meet the specific needs of all industries. We reproduce two photographs of plant in actual use and in all cases a very considerable saving of time and labour —and consequently expense—has been experienced.

In the particular instance illustrated China Clay in bulk

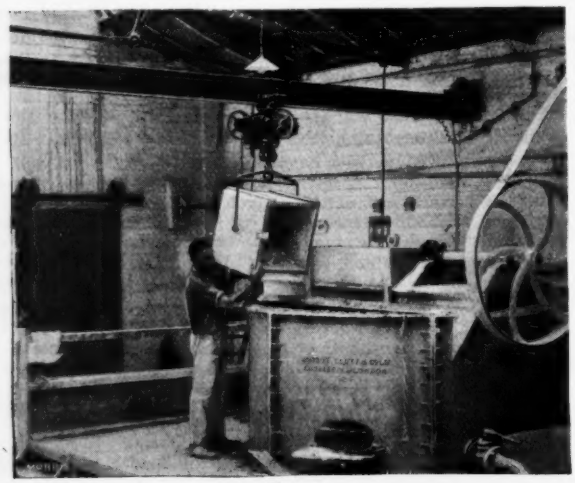


FIG. 1.

and the mixing machine are contained in one shop. The sole purpose of the runway is to transport the clay in skips, from the bulk pile (Fig. 1) on one side of the shop to the mixer (Fig. 2) on the other side, a distance of, say, 20 yards. One man only is employed for the work. In fit circumstances it would be well within the scope of the runway to unload bags of clay from a railway siding, lorry, etc., and to dump them at the mixer.

These pictures were taken in a large paper mill at Dartford, where large quantities of the clay are used. White newspaper

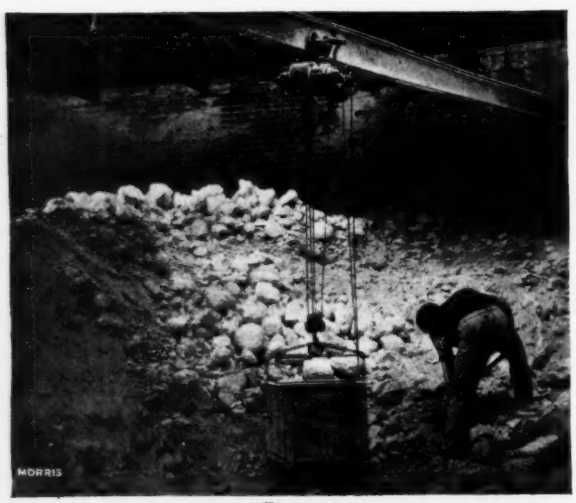


FIG. 2.

is their staple production, but most printing papers in general demand are produced. The working capacity of the Morris hoist is half a ton, and this handling is claimed to be ten times as fast as ordinary methods.

U.S.A. China and Ball Clays

Increasing Production

IN the U.S.A. Geographical Survey recently published, the following facts of interest to China Clay producers are given with reference to the production of China Clay and ball clay in the States.

The general prosperity of 1923 was shared by the clay-mining industry, which made the largest sales of clay yet recorded. The output in 1923 was greater by 320,816 tons, or 10 per cent., than that in 1917, the year of largest output prior to 1923. The value of the clay sold in 1923, however —87,750 dollars—was 0·8 per cent. less than in 1917, because the prices were lower. The increase in quantity over the output of 1922 was 786,960 tons, or 30 per cent., and the increase in value was 858,399 dollars, or 34 per cent. Every kind of clay named in this report, except stoneware clay, increased in quantity, and all increased in value. The decrease in stoneware clay compared with 1922 was small—5,477 tons, or 6 per cent. Ohio, the largest producer of stoneware clay in 1922, showed the greatest decrease owing to a strike in the great stoneware pottery region of that State. Slip clay showed the largest proportional increases—110 per cent. in quantity and 125 per cent. in value. Fire clay, which constituted the largest value of clay sold, and which represented 67 per cent. of the total in 1923, showed the largest increases—618,943 tons, or 37 per cent. in quantity, and 1,932,413 dollars, or 42 per cent. in value.

Ball clay, which is largely used in combination with kaolin in the manufacture of high-grade ceramic wares, increased considerably and reached its highest value. The figures were 620,978 dollars. The quantity of ball clay in 1923 was 10,338 tons, or 10 per cent. less than in 1917, the year of largest production, but 20,276 tons, or 26 per cent., more than in 1922.

Imports of clay in 1923 increased by 30,703 short tons, or 9 per cent. in quantity, and 266,348 dollars, or 8 per cent. in value, compared with 1922. Imports of every kind of clay reported increases in quantity and value except wrought clay, usually the smallest item among imported clays. The unwrought clays, which probably included ball clay, showed the largest increase—24,755 tons, or 61 per cent., in quantity, and 154,226 dollars, or 47 per cent., in value. Exports of clay increased. The quantity of clay exported increased by 37,219 tons, or 78 per cent., and the value by 195,295 dollars, or 45 per cent., compared with the previous year.

China Clay Company's Position

MR. JUSTICE LAWRENCE, in the Chancery Division on March 5, heard a motion for judgment in default of appearance in the debenture holders' action in *re* Central Cornwall China Clay Co., Lord Benson *v.* the Company.

Mr. Cecil Turner, in support of the motion, said that his Lordship had already appointed a receiver and manager. The plaintiffs were holders of two issues of debentures, one made in 1922 and the other in 1923, which ranked *pari passu*.

His Lordship made an order that plaintiffs were entitled to a charge upon the undertaking to secure repayment of the debentures and interest.

Ship Broker's Surplus

THE first meeting of creditors of William Varcoe Kellow, of Par, held at the offices of the Official Receiver (Mr. Coulter Hancock) at Truro, declined to accept a scheme put forward by debtor for payment of all creditors. The proposal of debtor was that out of moneys standing to his credit at Lloyd's Bank, amounting to £2,718, all creditors could be paid, in addition to all proper costs, charges, and expenses incidental to the proceedings. The amount to be withdrawn, it was suggested, should be ascertained by the official receiver and paid over to him for immediate distribution. The liabilities expected to rank for dividend, as shown in the statement of affairs, were £1,649, and the estimated assets £4,968, after payment of £237 preferential debts. The scheme not being approved, a trustee and committee of investigation were appointed. At the public examination at Truro Bankruptcy Court, it was stated by the official receiver that it had been transferred from the High Court and was not of the usual character, because in the statement of affairs a large surplus of assets over liabilities was shown. The examination was adjourned until the trustee could be present.

China Clay Notes and News

£300 for Clay-worker's Widow

On the application of Mr. J. C. Hubbard for Mrs. Rhoda Alice Horton, the widow, at St. Austell County Court, Judge Gurdon allocated the sum of £300, being the compensation money paid into Court in respect of the death of her husband, William John Horton, of Higher Stenalees, St. Austell, who was killed in H. D. Pochin and Co.'s South Caudledown China Clay works on October 17, 1925. The immediate payment out of £157 2s. 6d. and £1 per week in future was asked for and acceded to by the Judge.

Clay District Rate Reduction

A reduction in rates is always welcome news, and especially so to the China Clay industry, which is rated according to output. In the St. Austell Union rates (which include the poor and county rates) are to be reduced by 2d. to 3s. 7d. in the £ for the half-year to September, while the Rural District rates remain the same as before, at 2s. 7d. To meet special expenses in particular parishes, the following amounts are to be called up from those concerned in the China Clay industry: St. Austell Rural, £2,275; Roche, £685; St. Blazey, £780; St. Stephens, £1,548; St. Dennis, £1,008; St. Mewan, £30; Tywardreath (including Par Harbour), £806.

English China Clays, Ltd.

In the report to be presented at the seventh annual general meeting, the directors of English China Clays, Ltd., state that "the net profit for the year ended December 31, 1925, is £83,018 19s. 10d., compared with £85,879, for the preceding year. In the opinion of the directors this result, under the conditions prevailing, must be considered highly satisfactory. There is a movement now being made with a view to establishing another Association, but it is impossible at this juncture to make any forecast on the subject."

With the amount of £11,543 19s. 4d. brought forward, the total sum available for distribution is £94,562 19s. 2d. The payment of 7 per cent. dividend on the preference shares absorbs £21,282 1s.; the 4½ per cent. on the ordinary shares, £57,105, and the transfer to reserve £5,000, leaving a balance of £11,175 18s. 2d. to be carried forward. The balance sheet shows that of the 400,000 7 per cent. preference shares 304,136 have been issued, and of the 1,600,000 £1 ordinary shares, 1,269,000 have been issued. The general reserve of the company now stands at £25,000.

St. Austell Town Planning and China Clay Industry

At a recent meeting of the St. Austell Rural District Council, when the motion was brought forward for the preparation of a town planning scheme for the whole of the rural area, its effect upon the China Clay industry was inquired upon.

Mr. W. T. Nicholls, China Clay merchant, pointed out that in the China Clay areas, in consequence of the presence of clay deposits, they sometimes had to erect houses in difficult places. Although in favour of town planning he wanted to be certain that it would not be detrimental to China Clay interests. The Clerk (Mr. F. H. Smith) explained that there were provisions under the Act dealing with industrial areas which must be excluded from its operation if likely to interfere with trade development. They were not going to put any restrictions on the clay area but would deal with it in such a way that the principles of Town Planning would not apply to it. It would be a pity not to make the whole district the area for the scheme, but areas not to be built on would be so marked in the town plan. The Council decided to adopt the Act for the whole district.

Clay Merchants' Memorials

An impressive service was held in the St. Austell Parish Church on March 10, on the occasion of the dedication by the Archdeacon of Cornwall (the Venerable G. W. Hockley), of a stained glass window to the memory of Miss Elizabeth and Miss Maria Lovering, erected by their nephews, Messrs. John Lovering and William T. Lovering, and of two carved oak seats, one erected by Mr. Henry Sydney Hancock, to the memory of his wife and eldest son, Tom, and the other placed in the church by public subscription to the memory of the late verger, Edward Maddern Gribble. The Archdeacon was assisted in the service by the Rev. E. Roberts (Vicar of St. Austell) and the Rev. A. Cocking (Curate). The Archdeacon, clergy, and choir proceeded to the north aisle, where the Archdeacon dedicated the memorial window, and then proceeded to the memorial seats, which were also dedicated.

A powerful sermon was preached by the Archdeacon, who spoke of the lives of the departed and their connection with that church, saying that he thought it was a fitting tribute to their memory to beautify their church in that way.

The memorial window was inscribed as follows: "To the Glory of God and in memory of Elizabeth Lovering, born 8th July, 1816, died 5th February, 1904; and Maria Lovering, born 25th March, 1819, died 30th November, 1906. This window is erected by their nephews John Lovering and William T. Lovering."

First Cornish Concrete Road

The reconstruction of over half a mile of road with reinforced concrete through Mount Challes in the urban area of St. Austell is unique in the history of road-making in Cornwall, and through its success for carrying a large volume of continuous traffic, most of it China Clay, is likely to lead to further similar schemes being carried out by other authorities in the county. The Walker Weston Company, Ltd., of Victoria Street, London, secured the contract for their special Macrete process, which they have laid with great success in other parts of the country, a noteworthy instance being the laying of dock roads for the Port of London authority.

The road at Mount Charles has an area of 6,000 square yards, with a width of 30 ft. throughout. The advantage of the reinforced concrete road is that much less camber is necessary compared with the macadam water-bound road. Consequently the reconstruction of Mount Charles Road has involved the removal of enormous quantities of the surface of the road, ranging from 6 in. in the shallowest part to 15 in. in the thickest part. The thickness of the reinforced concrete is 7 in. at the crown of the road, reduced to 6 in. at the kerb. It is reinforced by double steel layer mats at the base of the crown and single steel layer mats at the sides, the effect of this reinforcement being to give great tensile strength to the road. For the carrying of heavy clay traffic such as traverses St. Austell on the way to Charlestown, and the transport of coal back, the road, which is costing over £6,000 and is guaranteed by the makers for five years, is looked upon as a step forward in road engineering in Cornwall.

Transport Workers' Former Secretary's Affairs

At St. Austell County Court, before Judge Gurdon, Charles Beresford Netherton, jettyman at Fowey, and formerly Branch Secretary of the General Transport Workers' Union, was before the Court on a judgment summons issued by the Union in respect of a sum of £34 (including a deficiency of £29 on defendant's books when acting as Branch Secretary, the balance representing costs). Mr. Thomas Charles Lewis, Area Financial Secretary of the Union, attended in support of the judgment to prove defendant's means to pay. Defendant disputed the amount, and said the most he thought that he owed was £17. Defendant explained that when he received the first summons he wrote to the Union headquarters asking to be informed how they made out that he owed so much and not receiving any reply he concluded the case would not come on until he did hear.

The Judge explained that the summons clearly stated that if he had any defence he had to communicate that defence to the Court within eight days, otherwise the judgment would go by default, and he not having done that, judgment was given against him. Defendant intimated that he did not understand that. In reply to questions as to means, defendant said he was paid piece-work and was paid a minimum wage of 12s. per day which depended on there being vessels to load. During the last fortnight he had earned £7 and in January he earned £14. He had a wife and three children.

His Honour decided to adjourn the summons to the next Court, in the meantime the defendant to file an affidavit setting out the details of his defence and to pay £17 into Court within ten days.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—February, 1926

Arrivals

Date.	Vessel.	From
January 30	*Nalan*	Cardiff
February 2	*Porthcarrack*	Plymouth
February 4	*Sunshine*	Truro
February 6	*Treleigh*	Newport, Mon.
February 7	*Ruth*	Barry
February 10	*Leelite*	Southampton
February 11	*Magrix*	Poole
February 13	*Fal Castle*	Falmouth
February 14	*Esperance*	Plymouth
February 15	*Snowflake*	Runcorn
February 15	*Robrix*	Par
February 18	*Pet*	Falmouth
February 19	*C. and F. Nurse*	Truro
February 24	*Zeemeeuw*	Plymouth
February 24	*Oak*	Plymouth
February 25	*Duchess*	Truro
February 26	*Ravenscraig*	Penzance
February 28	*Porthleven*	Cardiff

Sailings

Date.	Vessel.	Destination.
February 4	*Nalan*	Brussels
February 4	*Porthcarrack*	Rochester
February 7	*Sunshine*	London (Dartford)
February 12	*Treleigh*	Preston
February 13	*Leelite*	Tatport
February 13	*Magrix*	London (Gravesend)
February 15	*Falmouth Castle*	Manchester
February 17	*Robrix*	London (Gravesend)
February 17	*Esperance*	Boulogne
February 17	*Lady Daphne*	Rochester
February 24	*Pet*	Rochester
February 24	*C. and F. Nurse*	London (Dartford)
February 27	*Oak*	Fleetwood
February 27	*Ravenscraig*	Aberdeen
February 27	*Zeemeeuw*	Antwerp

Fowey Shipping—February, 1926

Arrived.	Name.	Sailed.	Destination.
February 1, S.S.	*Tynebridge*	February 15,	Philadelphia
February 1, S.S.	*Southwell*	February 5,	Rouen
February 1, S.S.	*Gouwestroom*	February 11,	Amsterdam
February 2, S.S.	*Porthcarrack*	February 3,	Charlestown
February 3, S.S.	*River Fisher*	February 6,	Preston
February 3, M.V.	*Nera*	February 9,	Gothenburg
February 3, S.S.	*Brier Rose*	February 9,	Ridham
February 4, S.S.	*Dorset Coast*	February 9,	Liverpool
February 4, M.V.	*Mayblossom*	February 6,	Plymouth
February 4, S.S.	*Brookside*	February 10,	Gijon
February 4, S.S.	*Wollaton*	February 10,	Antwerp
February 4, M.V.	*Tina*	February 13,	Genoa
February 5, S.S.	*Ruth*	February 10,	Skien
February 5, S.V.	*Matilda*	February 13,	Pentewan
February 6, S.S.	*Primrose*	February 16,	Preston
February 6, S.S.	*Ferndene*	February 13,	Antwerp
February 6, S.V.	*Annie*	February 13,	Pentewan
February 7, S.V.	*Flying Foam*	February 18,	London
February 8, S.S.	*Farfield*	February 12,	Fleetwood
February 9, S.S.	*Tirydail*	February 18,	Antwerp
February 9, S.S.	*Leelite*	February 20,	Charlestown
February 10, S.S.	*Scartho*	February 19,	Terneuzen
February 10, S.S.	*Monksville*	February 13,	Leith
February 11, S.S.	*Southwell*	February 13,	Bilbao and Pasages
February 12, S.S.	*Overton*	February 16,	Birkenhead
February 12, S.V.	*Esperance*	February 13,	Charlestown
February 12, S.S.	*Martha*	February 18,	Brussels
February 12, M.V.	*Anna*	February 18,	Gravelines
February 14, S.S.	*Guelder Rose*	February 17,	Preston
February 15, S.S.	*Wild Rose*	February 17,	Preston
February 15, S.S.	*Jufuku Maru*	February 24,	Boston and Newport
February 16, S.S.	*Teesbridge*	February 24,	Portland, Me.
February 16, S.V.	*Mildred*	February 23,	Cardiff
February 17, S.V.	*W. E. Gladstone*	February 25,	Pentewan
February 17, S.S.	*Pylades*	February 20,	Methil
February 18, S.S.	*Dorset Coast*	February 22,	Liverpool
February 18, S.S.	*Orenic*	February 20,	Ridham
February 18, S.S.	*Percy*	February 23,	Brussels
February 18, S.S.	*Helga*	February 24,	Leghorn
February 18, S.V.	*Mary Sinclair*	March 1,	London
February 19, S.S.	*Rossmore*	February 24,	Bo'ness
February 19, S.S.	*Brynawel*	February 20,	Penryn
February 20, S.S.	*Alice*	February 24,	Preston
February 20, M.V.	*William Ashburner*	February 26,	Rochester
February 20, S.S.	*Florence Cooke*	February 22,	Portmadoc
February 20, S.S.	*Pansy*	February 23,	Ridham
February 21, S.S.	*Horn*	February 24,	Rouen
February 21, S.S.	*Joffre Rose*	February 25,	Preston
February 22, S.S.	*Marie Schroder*	February 26,	Hamburg
February 22, S.S.	*Blenda*	February 27,	Norfolk, Va.
February 22, M.V.	*Annie*	February 24,	Truro
February 23, S.S.	*Mersey*	February 25,	Runcorn
February 23, M.V.	*Hope*	February 25,	Looe
February 23, S.S.	*Fernside*	February 25,	Pentewan
February 24, S.S.	*Seaforth*	February 27,	Fleetwood
February 24, M.V.	*Dietrich Haseldiech*	February 27,	Bremen
February 24, S.V.	*Prima*	March 2,	Leith
February 24, S.S.	*Brier Rose*	February 26,	Runcorn
February 25, S.S.	*Guelder Rose*	March 1,	Western Point
February 25, S.S.	*Rosafred*	March 1,	Norrkoping
February 26, S.S.	*Falmouth Castle*	February 27,	Runcorn
February 26, S.S.	*Gouwestroom*	March 2,	Amsterdam
February 26, S.V.	*Fanny Crossfield*	*	Ardrossan
February 27, S.S.	*Southwell*	March 4,	Rouen
February 28, M.V.	*Altair*	March 3,	Drammen
February 28, S.S.	*Farfield*	March 4,	Grimsby
February 28, S.S.	*T. P. Tilling*	March 3,	Preston

* Signifies "In Port."

Par Harbour Shipping—February, 1926

Arrivals

Date.	Vessel.	From
February 2, S.S.	*Oaktown*	Plymouth
February 3, S.V.	*Isabella*	Falmouth
February 4, S.S.	*Porthleven*	Plymouth
February 10, S.S.	*J.W.N.*	Plymouth
February 11, S.S.	*James Tennant*	Dartmouth
February 14, S.S.	*Trader*	Bridport
February 14, S.S.	*Robrix*	Teignmouth
February 15, S.S.	*Freighter*	Blyth
February 19, S.V.	*Ivy*	Falmouth
February 20, S.V.	*Western Lass*	Mevagissey
February 20, S.V.	*Hector Cundy*	Falmouth
February 22, M.V.	*Capable*	Poole
February 23, S.V.	*Alert*	Truro
February 24, S.S.	*Braebeg*	Dartmouth
February 24, S.V.	*Snowflake*	Charlestown
February 26, S.S.	*Velocity*	Newlyn
February 26, S.S.	*Fernside*	Pentewan
February 27, S.S.	*Treleigh*	Portreath

Sailings

Date.	Vessel.	Destination.
February 3, M.V.	*Haldon*	Penarth
February 4, S.V.	*Mary Barrow*	Rochester
February 10, S.S.	*Oaktown*	London
February 10, S.S.	*Porthleven*	Irvine
February 11, S.S.	*J.W.N.*	Gravesend
February 12, S.S.	*James Tennant*	Rochester
February 15, S.S.	*Robrix*	Charlestown
February 16, S.S.	*Trader*	Rochester
February 16, S.V.	*Isabella*	London
February 19, S.S.	*Freighter*	Gravesend
February 24, M.V.	*Capable*	Rochester
February 25, S.V.	*Ivy*	Rochester
February 26, S.S.	*Velocity*	Newlyn
February 27, S.V.	*Hector Cundy*	Rochester
February 27, S.S.	*Braebeg*	London

No China Clay Imports in February

THE official returns show that there were no registered imports of China Clay or China Stone into Great Britain or Ireland during the month ending February 28, 1926.

Par Harbour Tide Table, April, 1926

(*Greenwich Mean Time Throughout.*)

Day of Week.	Day of Month.	Morning.	Afternoon.	Height.
Thursday	1	7.12	7.27	12.11
Friday	2	7.43	7.59	12.8
Saturday	3	8.16	8.34	12.2
Sunday	4	8.53	9.14	11.5
Monday	5	9.38	10.5	10.8
Tuesday	6	10.36	11.14	10.1
Wednesday	7	11.58	—	9.10
Thursday	8	0.46	1.32	10.6
Friday	9	2.14	2.51	11.6
Saturday	10	3.25	3.53	12.7
Sunday	11	4.19	4.43	13.6
Monday	12	5.6	5.29	14.0
Tuesday	13	5.51	6.12	14.2
Wednesday	14	6.32	6.51	14.1
Thursday	15	7.9	7.27	13.7
Friday	16	7.45	8.4	12.11
Saturday	17	8.22	8.41	12.0
Sunday	18	9.1	9.22	10.11
Monday	19	9.45	10.10	9.11
Tuesday	20	10.39	11.14	9.3
Wednesday	21	11.56	—	9.0
Thursday	22	0.39	1.21	9.5
Friday	23	2.0	2.34	10.0
Saturday	24	3.2	3.27	10.11
Sunday	25	3.49	4.9	11.8
Monday	26	4.28	4.47	12.3
Tuesday	27	5.5	5.21	12.9
Wednesday	28	5.39	5.55	12.10
Thursday	29	6.12	6.30	13.1
Friday	30	6.47	7.6	13.1

E. CLEMENS, Harbour Master.

China Clay Exports for February, 1926

A RETURN showing the exports of China Clay, including Cornish or China stone, the manufacture of the United Kingdom, from the United Kingdom to each country of destination, as registered during the month ended February 28, 1926.

Country of Destination.	China Clay. Quantity.	Value.
	Tons.	£
Sweden	1,136	2,559
Norway	577	650
Germany	592	804
Netherlands	2,062	3,866
Dutch Guiana	104	381
Belgium	6,828	10,470
France	1,826	2,488
French Possessions in India	20	93
Portugal	20	60
Spain	1,107	1,892
Italy	591	1,773
China (exclusive of Hong Kong, Macao and leased territories)	5	27
United States of America	33,109	66,015
Mexico	70	299
Brazil	1	5
Irish Free State	—	1
Bombay, via Karachi	1	4
Other Indian Ports	969	3,752
Madras	85	281
Bengal, Assam, Bihar and Orissa	705	1,903
Australia	56	298
New Zealand	2	9
Canada	1	5
Total	49,867	£97,635

February's Good Figures

A BIG turnover in tonnage was experienced by China Clay firms in February, which, though a short month, showed an increase in total tonnage of 15,000 tons compared with January. Thus last year's monthly positions were reversed. Fowey was responsible for dealing with nearly the whole of this increased tonnage. Judged on a monthly basis, February was the best since October last year, the total recorded having been exceeded only three times last year. Taking China Clay tonnage alone, last month's total was only once exceeded last year, namely in March, when 94,217 tons were delivered. On the two months, February has now put the total

(*Continued in next column*).

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

BISHOP AND STONIER (1926), LTD., Hanley, earthenware manufacturers.—Registered February 2, £9,000 debenture, to F. Marks, Hanley, and another; general charge.

FORESTER (THOMAS) AND SONS, LTD., Longton, earthenware manufacturers.—Registered January 15, £10,000 debentures; general charge. *Nil. February 5, 1924.

MAW AND CO., LTD., London, E.C. tile manufacturers. Registered February 25, £25,000 debenture, to J. S. Barker, 1, High Street, Iron Bridge, and another; general charge (ranking next to £2,100 prior lien debentures); also registered February 25, £26,000 debentures; general charge (ranking next to £2,100 prior lien debentures and £25,000 1st debenture); also registered February 25, £5,900 debentures; general charge (ranking next to £2,100 prior lien debentures. £25,000 1st debenture and £26,000 2nd debentures). *£52,871. December 19, 1923.

MOWBRAY TILE CO., LTD., London, W.C.—Registered January 4, £700 debenture, to J. E. Trigge, 14, Norfolk Street, W.C., director of public companies; general charge.

REIGATE BRICK AND TILE CO., LTD. Registered February 3, £4,000 debenture, to A. A. Pepper, 16, Evesham Road, Reigate; general charge (subject to prior charge); also registered February 3, £8,000 debentures; general charge (subject to prior charges).

SWALLOW'S TILES (CRANLEIGH), LTD.—Registered January 19, £11,000 (not ex.) charge, to bank; charged on properties at Cranleigh, etc.

SWALLOW'S TILES (CRANLEIGH), LTD.—Registered January 6, £18,000 debentures; general charge.

UNITED PAPER MILLS, LTD., Cardiff. Registered February 11, £500 debentures; general charge. *Nil. April 1, 1924.

Satisfactions

PEARSON (JAMES), LTD., Chesterfield, pottery manufacturers.—Satisfaction registered February 9, £1,000, part of amount registered February 6, 1920.

REDHILL TILE CO., LTD.—Satisfactions registered January 7, £1,000 (not ex.), registered July 17, 1924; and £1,000 (not ex.), registered January 21, 1925.

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turnover in all classes well ahead of last year's total for the corresponding period, as well as that of 1924. The totals are, this year, 158,622 tons; last year, 152,082 tons; 1924, 117,168 tons.

Here are the details for February compared with February, 1925:—

Port.	China Clay. Tons. 1926.	1925.	China Stone. Tons. 1926.	1925.	Ball Clay. Tons. 1926.	1925.	Total. Tons. 1926.	1925.
Fowey	66,422	53,880	3,154	3,091	1,558	614	71,134	57,585
Charlestown	4,413	4,072	—	—	—	—	4,413	4,072
Par	3,164	1,741	—	321	—	—	3,164	2,062
Penzance	808	500	—	—	—	—	808	500
Plymouth	597	1,276	12	24	—	—	609	1,300
Falmouth	180	—	—	—	—	—	180	—
Looe	195	123	—	—	—	—	195	123
By Rail	5,552	5,394	—	—	—	—	5,552	5,394
Total	81,331	66,986	3,166	3,436	1,558	614	86,055	71,036
January	66,520	75,490	3,742	2,506	3,156	3,050	72,567	81,046
Total, 2 months	147,851	142,476	6,908	5,942	4,714	3,664	158,622	152,082

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., 8, Bouverie Street, London, E.C.4. All communications relating to Advertisements, Subscriptions and other business should be sent to the Manager, "The China Clay Trade Review," at the same address. Telegrams—"Allangas, Fleet, London." Telephone—City 9852 (6 lines).

Views on a New Association

SINCE the initial meeting of the China Clay producers of Devon and Cornwall at St. Austell last month, at which it was agreed that the time is ripe for the formation of another association (as briefly announced in our last issue), great satisfaction has been manifested at the spirit of co-operation that prevailed. The producers very much appreciated the calling of the meeting by the Lord-Lieutenant of Cornwall (Mr. J. C. Williams), who, because he has no direct connections with the China Clay industry, appealed to all as an impartial chairman. The conclusions arrived at at this preliminary meeting were as satisfactory as any of the producers had hoped for. There had been no course of action mapped out beforehand; it was left by the promoters of the meeting to the producers to make their own suggestions as to the steps to be taken. The practically unanimous decision of the producers attending the meeting, who represented all sections of the trade, and included members of the old association and of China Clay Producers, Ltd. (the existing association for best clays), is a very hopeful sign. The conclusions arrived at indicated unanimity that the present unrestricted competition is having a very serious effect upon the financial position and stability of many firms, there being general agreement that something should be done to end the present state of things.

It was natural that the meeting should wish to know what would be the attitude of the present best clays association to a proposal for an association to embrace all branches of the industry; hence the appointment of a strong representative committee to wait upon the association as a first step. From opinions that have been expressed by members of the best clays association, it is not likely that they will entertain the merging of their association into one embracing the whole industry unless they are assured of something like unanimity on the part of all the producers. This is a reasonable stipulation for a successful, smooth-running, established organisation to make. The result of the first meeting of the committee with the board of China Clay Producers, Ltd., which is to be communicated to a later meeting of all the producers, is being awaited with keen interest. If it is found that the best China Clay producers are prepared to co-operate in the new movement, it will be up to all producers alike to work for its successful accomplishment, so that producers and workers may gain the rewards to which they are entitled.

English China Clay's Attitude

The frank announcement made by Mr. R. Martin (chairman and joint managing director of English China Clays, Ltd., one of the "Big Three" engaged in the industry) as to the attitude of his company, has been received with much satisfaction by the general body of producers. As was pointed out by Mr. Martin, there is less necessity for his firm to join an all-embracing association than for the majority of other firms, because English China Clays, Ltd., have a preponderance of best clays, which are only slightly affected by the unrestricted competition in the medium and common clay classes. Their balance sheet reveals this fact to a very marked degree. They have been able during the past year to pay their shareholders on their enlarged capital 4½ per cent. and to keep up to date the payment of the dividend on their 7 per cent. preference shares. Mr. Martin's pronouncement is additionally welcome because English China Clays, Ltd., are among the chief members of China Clay Producers, Ltd., on whom the deputation representing all the producers have been appointed to wait. This is an indication that the best clay producers' association are disposed to consider favourably any proposals the committee may make. We are in a position to state authoritatively that the committee set up at the general meeting of producers, of whom Sir H. Montague Rogers (of Cornish Kaolin, Ltd.) has been appointed chairman, have had one or two meetings, and agreed on certain lines of procedure preparatory to their meeting the board of China Clay Producers, Ltd. The latter body have intimated their willingness to confer with the committee and discuss the subject of an all-embracing association, and to this end a meeting has been arranged to take place within the next fortnight. The result of that meeting will be communicated to producers in general very soon after.

Bearing on the Wages Question

The setting up of another association does not affect the master producers alone, but has a very distinct bearing upon the future wages and conditions of the men employed in the industry. Under present conditions it is obvious that the industry as a whole cannot pay higher wages. But if, by continuing to remain apart, the producers continue to limit their capacity to pay more wages, they will have to reckon with their workmen, who are as much interested in the new association movement as the producers. This important aspect follows naturally because the latter have ascribed their inability to pay more wages to the low prices at which they are forced to sell their clays owing to unrestricted competition. The drawbacks of the absence of an organisation to safeguard the interests of the industry with a big and increasing over-production have been proved beyond question, the absurdity of the position being that the industries supplied with the valuable raw material are making good profits and paying their workmen high wages. The question that the industry may have to face, in the event of unanimity depending on one or two obstinate producers, is whether some steps shall be taken to bring them into line with the general body. The thousands of men engaged in the production of China Clay are therefore watching with the keenest interest the progress of the steps being taken in the formation of another association, of which they are whole-heartedly in favour. The drastic action, which they were reported to have decided upon consequent upon the recent refusal of their application for increases, is being suspended pending the results of the present movement on the part of the master producers. A great deal more depends upon the formation of another association than the protection of the industry from the employers' point of view. The employees' position and intentions are well worthy of consideration, to say nothing of the shareholders in companies that are at present offering no dividends.

English China Clays, Ltd.

Chairman in favour of New Association

THE remarks of Mr. R. Martin, chairman and managing director of English China Clays, Ltd., at the seventh annual meeting of the company in London on March 30, have been welcomed in China Clay circles mainly on account of the disclosure of the company's attitude towards the formation of a new Association.

After the Secretary (Mr. H. S. Andrew) had presented the report of the auditors, the Chairman, in moving the adoption of the report and statement of accounts, said that, in comparing the results of the year's working with those of 1924 it must be borne in mind that whereas in that year the prices ruling were for nine months of the period on a more remunerative level, due to the existence of the Associated China Clays, Ltd., the prices during the whole of 1925, especially of the medium and common qualities, had been seriously affected by the unrestricted competition. He therefore ventured to hope that the results the Board were able to lay before the shareholders exceeded their expectations. (Hear, hear.)

The profits for the year amounted to £83,018, as compared with £85,879, and there was an available balance of £47,900, which the directors recommended should be applied as follows :—The payment of a final dividend on the ordinary shares of 2½ per cent., making 4½ per cent. for the year, absorbing £31,725, and the transfer to general reserve of £5,000, leaving a balance to be carried forward of £11,175.

Best Clay Prospects

The non-existence of the Associated China Clays, Ltd., had had a serious effect on the China Clay trade generally. Large quantities of clays of the lower grades had been disposed of at, or even below, the cost of production, and it was small wonder that efforts were now being made by producers who were chiefly concerned with those grades to bring into being another Association. The Board would naturally give their hearty support to such a movement, provided that it had the loyal co-operation of the whole trade, combined with a real and honourable determination to abide by the rules and regulations. The past year's working had demonstrated very clearly that the main strength of English China Clays lay in its possession of a preponderance of best clays, and there was not, therefore, the same urgent incentive to the formation of a new Association in their case as in that of those less fortunately situated.

The volume of trade for 1925 had been satisfactory, approximating very nearly the pre-war figure, and in this company's particular case equalling, within a few tons, the boom year of 1920. America had enjoyed a year of great prosperity and had again proved their best customer. Owing to the instability of the foreign exchanges, business on the Continent had been very difficult and there seemed to be little prospect of any return to the pre-war demand from that quarter until more stable conditions prevailed. Demand from the home market had been good for both filling and coating clays for paper-making, but the pottery and cotton trades had shown scarcely any signs of activity. The uncertainty hanging over the coal industry, and consequently over the whole country, was undoubtedly having a hindering effect on trade generally. He thought, therefore, that if a satisfactory solution of that difficulty could be found, and found quickly, we should see a most welcome revival.

Works Development

Considerable expenditure had been incurred during the year on works account. The new power station at Dorothy had been completed and the engines were being installed. A new grinding mill of ten pans capacity had been erected at Ponts Mill with a view to utilising the surplus water power during the winter months, and the water turbine had been delivered. The work on the new kiln at Lee Moor had made good progress, and it was hoped to have it in operation within the next few months. The past winter had been a very trying one for clay works, but he was pleased to be able to report that the company's pits had suffered no material damage, only three slips of minor importance having occurred, and in neither instance had any overburden found its way into the stopes.

With regard to the outlook for the present year, he desired to say that the orders in hand exceeded those booked a year ago and the outlook generally was very encouraging. In conclusion, he desired to pay a sincere tribute to the staff, both indoor and outdoor, who had so loyally and ably assisted in creating the results which the shareholders had before them that day. (Applause.)

Mr. T. Medland Stocker, J.P., seconded the resolution, which was supported by Mr. Walter Sessions (managing director), and it was unanimously adopted.

Suggestions for Proposed Association

Points raised by China Clay Producer

MR. C. R. SKYNNER, of Charlestown, St. Austell, in a recent letter to the *Western Morning News* stated that :—

" I know some producers have in their minds the possibility of a loss of trade in the American market for potting clays. I can assure you from interviews I have had with American manufacturers of earthenware in the States that that fear only exists in the China Clay producers' own minds. I think I have been rightly informed when told that whatever price China Clay was put up to by the Cornish China Clay producer, the American, from a potting point of view, would be bound to buy it.

" The American or domestic China Clay, although excellent in colour and more or less plastic, when placed in the oven for firing in biscuit has the tendency to a very sudden and fierce contraction, with a consequence that were they to use nothing but domestic China Clay the whole of their biscuit ovens would be thrown on the dump, and would never reach the glost. On the other hand, English clay productions slowly swell when placed under fire, and, having slowly swollen, they slowly contract. This fact alone will always enable the Cornish producers to send their share into the American market.

" The paper side is divided into two classes, the best facing clays for high calendered papers and the loading clays for the printing of news, bags, etc.

" I am told that there is no substitute at anything like the price for this fine China Clay which is used for facing papers, and that if the price was considerably higher than the present figure, which has never been lowered much, if at all, they would still be prepared and willing to buy it.

Outside Agreement to Association

" I produce China Clay for a large paper manufacturing firm at Sheffield, who own their own China Clay works, so I am in a position to speak, and, although they produce China Clay for their own mills, the chairman writes that he will join the association and abide by its ruling as to production and price. This powerful manufacturer from the North has expressed to me his sympathy for the state our industry is in, and I believe if other manufacturers were approached for their views the same opinion would be given.

" Their buyers are business men, and are out to do the best they can for their employers, but, if the China Clay producer is fool enough and mad enough to throw his production away, can you blame these business men for taking advantage of the situation ?

" To my mind an association is essential, and it should come as quickly as possible. It should be formed with the idea of the little man having as large a say and as much weight as the big man ; jealousy one for the other should be totally eliminated. I would ask the association to bear in mind the merchant and distributor of China Clay, whom they are pleased to designate as middlemen (a very ill-conceived title, in my opinion), should they require help and advice when trouble and tribulation are experienced.

" In regard to the committee for pricing the association's various kinds of clay, especially potting clays, I would suggest pricing committees be formed for the four kinds of China Clay, viz., best china, best semi-porcelain, best and medium earthenware, and clays for majolica and common potting purposes.

" Persons on that committee should not only understand the properties of the various clays, but also be members of the trade who are themselves in constant touch with the buyers, and who are able to give correct and proper advice as to values.

" I believe that if an association is formed and everyone joins, absolute success can be attained provided they all stand shoulder to shoulder, back to back, and whichever way competition is thrust against it, an undivided front is put up in defence."

China Clay in Paper Making

Practical Points for China Clay Producers

[We are glad to print the following practical notes by a paper-maker in close touch with the technical side of the industry. The details of the consumers' particular requirements should prove useful to China Clay producers.]

IN the manufacture of paper, China Clay is used chiefly as a loading material. There seems to be a pretty general opinion outside the paper trade that China Clay is used for bleaching and the term " bleaching clay " is frequently employed, but clay will not " bleach " any other material. A good white clay will, to use the paper-maker's phrase, " help the colour," but this is not bleaching in the ordinary sense of that word.

A loading material in paper must not be regarded as a form of adulteration. There are several kinds of loading material, and each of these is employed to effect a result that is desired by the user of the paper. China Clay fills the pores of the paper and gives a sheet of a closer texture and with a smoother surface than could be obtained without it, and further, it renders the paper more suitable for taking printer's ink. It decreases the strength of the paper and consequently is not used in those papers that must stand severe tests for strength and folding capacity—except in papers that must be thin as well as strong, and here a little loading material, generally China Clay, may be introduced to make the paper opaque.

Coated Papers

In this country China Clay is seldom, if ever, used alone for coating papers, but clays of exceptional whiteness are used in conjunction with such materials as blanc fixe or satin white. Imitation art papers, however, contain a large percentage of clay, which is mixed with the pulp in the beaters.

It should perhaps be explained here that coated or art paper is a paper that has had an actual coating of mineral matter placed upon it after the paper has been made, and this body paper, as it is called, can be coated on one side only, or on both sides, as may be required by the user. The mineral matter, or " colour " is mixed with a sizing material such as gelatine or casein, and, as has been previously stated, China Clay forms only a portion of the mineral preparation. There is an interesting test (of the variety of " rough and ready ") which is frequently applied to coated or art papers. The edge of a silver coin is drawn along the surface and this leaves a mark similar to that made by lead.

Qualities of Clay Required

There does not appear to be any standard of quality for China Clay that will appeal to all paper-makers alike. It is safe to say that a clay that is acceptable in one paper mill may be rejected by another. Generally speaking, there are three characteristics that count for excellence. These are (1) whiteness, (2) carrying capacity or fineness, and (3) absence of grit and foreign matter generally—in other words, purity or cleanliness of the clay. Some paper-makers seem to make No. 3 the chief virtue of China Clay : others do not mind the presence of grit so long as the clay is of good colour.

Undesirable Foreign Matter

Without doubt much could easily be done by producers of China Clay to prevent foreign matter from getting into the clay, quite apart from the question of grit, which comes from the original deposit. Before the clay can be mixed with the pulp it is reduced to a liquid state and then strained, and in this straining a weird and wonderful collection of material is obtained ; indeed it is doubtful whether the China Clay producers would believe that this collection came from their clay. Coal dust, fragments of wood, sticks, grass, string, pieces of candles and lengthy fibrous materials (which are said to come from engine packing) are frequently found, and a man has to stand by to clear the sieves.

Differences of opinion exist as to the best shade of white to be desired in clay. Some makers prefer what they term a dead white, others a blue white, and some again an ivory white.

The carrying capacity of a clay is, it is to be presumed, a natural characteristic, which remark will apply also to colour, though it is stated that aniline blues are sometimes added to the clay by the producer.

China Clay Producers Meet

New Association Favoured

LAST month we were able to make a brief reference to the result of the long anticipated conference of China Clay producers called by Mr. J. C. Williams (Lord-Lieutenant), who presided, on Wednesday, March 17. The object of the meeting, as stated in the notice convening it, was that " the present position of the China Clay industry may be discussed by those concerned."

The medium and common China Clay producers were very largely represented, over 50 representatives of firms attending. There was a long discussion on various phases of the industry, but with little dissension. Eventually the meeting passed a resolution to the effect that the time was ripe for the formation of another association to embrace the whole industry. A committee of nine was appointed to wait upon the best China Clay producers, who at present have an association of their own, to ascertain their views on the subject of an association of all the producers and to report to a further meeting the result of the deputation's interview.

The appreciation of the China Clay producers of the Lord-Lieutenant's action in calling them together was expressed by Sir H. Montague Rogers and Mr. E. J. Hancock, and a resolution was passed thanking Mr. Williams for his interest.

At the close of the conference the Committee met and chose as their chairman Sir H. Montague Rogers.

China Clay Research Items

Preparation of Casting Slips

THE viscosity of a clay slip is affected by numerous factors, important amongst the latter being the method of preparation. The various clays require different modes of procedure in order to obtain the desired viscosity. By varying the reagent used with one slip, dissimilar results occur. Variations in the viscosity of a casting slip may be obtained by using different percentages of the alkaline reagent employed and water. During a number of experiments, slips of a high viscosity were obtained by adding the water first to the blunger followed by the sodium carbonate and silicate simultaneously and subsequently the clay. When the sodium carbonate was added prior to the clay and finally the sodium silicate, slips of low viscosity resulted. When filterpress cakes were used ground with water and alkaline reagents, slips of low viscosity were produced in cases where the cakes were employed wet. Similar results were recorded when the sodium carbonate was introduced before the sodium silicate. Higher viscosity was produced by grinding the slips than when the latter were blunged. To maintain a uniform minimum viscosity it was found more important to keep constant the ratio of the alkaline reagent to clay than the ratio of alkali to water.

Elutriation Tests on Kaolins

Comparative tests with regard to the size of grains were conducted between English and German primary and secondary kaolins, using for the purpose an apparatus containing a series of four cylinders on the Schultz elutriator principle. The respective diameter of the cylinders was 7·5 cm., 13·5 cm., 21·5 cm. and 30 cm. A stream of water travelled in succession through these cylinders with an upward velocity of 0·7, 0·18, 0·8 and 0·04 mm. per sec. respectively. After deflocculation, in the case of most of the kaolins treated in the foregoing manner, the proportion of particles left behind subsequent to passing through the 30 cm. diameter cylinder with a water velocity of 0·7 mm. per sec. was inconsiderable.

The grains of the different clays were most readily and satisfactorily determined by the proportion of material retained on a 13·5 cm. cylinder with a water velocity of 0·18 mm. per sec. The amount of material retained on the latter vessel varied approximately from 4 to 26 per cent. This variation was much less marked when the material travelled through a 21·5 cm. vessel with the same velocity. Great similarity between the grains of English China Clay and German kaolins was displayed throughout the tests, but in the case of several of the secondary English kaolins the proportion of coarse particles present was found to be very large.

British Vice-Consul's Patent

Process for Bleaching China Clay

In the process outlined in B.P. 131,132 the clay is placed in a vessel, together with some metallic zinc, and water charged with sulphurous anhydride gas (SO_2). The presence of the zinc immediately reduces the anhydride to hyposulphurous acid (SO), which dissolves the colouring matters and leaves the clay in its natural pure white colour.

No special type of apparatus is required for the operation, but it is advisable that the vessel be acid proof. Carboys similar to those used for sulphuric acid are very suitable, mounting them on trunnions so that they may be revolved. For laboratory trials it is best to use a shallow dish of sheet zinc, on which the clay is mixed with the solution of anhydride. In this manner the reaction is seen, because the colour at once begins to disappear, and after a short while the charge is poured into a glass bottle and corked to prevent precipitation of dissolved oxides by contact with the atmosphere. In a short time the bleaching is complete ; then the clay is allowed to settle, the solvent with the colouring matter is removed, and the clay is thoroughly washed with water to remove all trace of acid, and dried.

In bringing his patent to the notice of China Clay producers, Mr. Augustus J. Stubbs, who is British Vice-Consul at Castellon, in Spain, writes : " As producers of China Clay I assume you may have classes that would be improved if bleached, and in this connection I beg to inform you that I possess a patent process that, so far, has successfully bleached to pure white every sample that has been submitted to it, with the advantage that it dissolves out every trace of iron. To enable you to judge of the success of my process, I enclose herein sample, in the crude state and also bleached, of a clay that is mined in this district. The process cannot be more simple as it consists of a single reaction ; it is also rapid and inexpensive. In dealing with the clay and working on the scale of 20 tons per day, the cost does not exceed five shillings per ton. You will best judge of the enhanced value of the bleached product.

" If the matter interests you, please note that I am prepared to grant you a licence at a moderate royalty, and if you would wish me to test a sample of your clay, kindly send me a post sample of 8 or 10 ounces. I am British Vice-Consul for this district, and desirous of British and not foreign trade being fomented ; I also trust that my countrymen will take up my invention for our mutual benefit."

The sample sent certainly justifies Mr. Stubbs's claims. His patent should prove useful.

Canadian China Clay Statistics for 1925

The preliminary report on the mineral production of Canada during 1925 has just been issued. The official figures reveal that Canada imported 363,890 cwt. of China Clay with a total selling value of $195,032 during 1925. In 1924 the corresponding figures were 390,613 cwt. at $250,113. Pipe clay imported during 1925 was valued at $1,668 in 1925 against 847 cwt. in 1924.

Exports of unmanufactured clays during the year were valued at $8,496 against $1,127 in 1924. Clay products account for 5 per cent. of the total capital invested in the mining industry and some 11,000 are employed in the production of structural and clay products.

There were no shipments of kaolin in Canada during 1925. In 1923 some 163 tons of this commodity were shipped from the St. Remi d'Amherst deposit in Quebec. During the year under review, considerable development was done on the China Clay deposits on the Mattagami river, near Long Falls, Temiskaming district, Ontario. The prospects of this deposit becoming a large producer within the course of the next few years seem favourable, says the report.

A Lead from St. Austell

At a recent meeting held to discuss a proposed cottage hospital for Newquay Mr. J. W. Higman, chairman of the St. Austell Hospital, gave some figures relating to that hospital. The hospital had been a boon and blessing to the district and had been extended from 10 to 24 beds. In 1924 they had 350 admissions and 300 operations. The expenditure for 191 was £1,604 and they had a balance of £578 to the good. They expended £3,000 on the extensions and that was all subscribed before they started. They had one bed for every 1,000 of the population. Ten beds would cost about £1,600 a year. The clay workers had subscribed £392 last year, which was very satisfactory. He invited a committee to visit the St. Austell Hospital for information. Mr. Higman said that the St. Austell Hospital cost £7,000 to start.

Dr. Swift thought the question a difficult one for a place like Newquay. St. Austell had a clientèle of patients and had many rich people in the district. They had not that in Newquay.

Tehidy Minerals, Ltd.

Steady Progress Reported

This company, which is largely interested in China Clay properties as royalty owners, announces a profit of £10,744 for last year and gradual improvement in its position from increasing revenue and diminished expenditure. The year has been one of steady progress in the development, directly and indirectly, of the company's mineral resources, and the stability of the tin market has continued well into the current year. With reference to its China Clay interests the company states that the China Clay trade has been carried on under conditions very disadvantageous for common clays. After the disbandment of the association, these clays, owing to overproduction, dropped seriously in price. On the other hand, best clays nearly maintained their price, which had been fixed by the best clays association. For the year the total output of Cornwall and Devon had been very close to the best prewar year, and from the present trend of the trade it appeared that the present year's output would also be on a satisfactory basis.

Directory of Paper Makers

The 50th annual issue of the *Directory of Papermakers* has just been published by Marchant Singer and Co., 48, St. Mary Axe, London, E.C.3, 5s. net. It is, of course, a comprehensive and indispensable reference book for all connected with the paper trade, not excepting the China Clay industry. The lists have been completely revised since last year and the following items from the contents show the nature of the volume. Alphabetical list of paper makers ; paper enamellers, gummers, etc. ; paper makers' representatives in London and provinces and mills represented ; London wholesale stationers ; mills with names of occupiers ; mills arranged in counties, with maps ; numerical list of mills ; classification of makes, with makers' names ; trade designations used by paper makers, wholesale stationers, etc. ; paper trade customs ; sizes of paper, etc. The importance of the paper industry to China Clay producers is sufficient to recommend this reference book to all who would keep up with developments and new enterprise.

St. Austell Petty Sessions

At St. Austell Petty Sessions on Wednesday, April 7, before Colonel A. S. Hext (in the chair), Messrs. J. W. Higman, W. J. Nicholls, W. Tresidder, W. Boxhall, S. Mitchell, C. J. Richards, W. Light, Arthur Rowett.

Clay Worker's Plight

On behalf of Tregrehan Estate Dr. Newcome Wright (Stephens, Graham, Wright and Co.) applied for the enforcement of the closing order against a clay labourer named Jabez Brokenshire, who with his wife and six children are occupying a two-roomed cottage which it was said was not fit for habitation. The Bench thought it a hard case and decided to allow Brokenshire three months to enable him to get another house.

China Clay Merchant Fined £4

Cyril Cornish, China Clay merchant, St. Austell, sent a letter explaining non-appearance in answer to charges of riding his motor-cycle without a light and driving it without having a driving licence. P.C. Scantlebury said that when he signalled the defendant to stop he failed to do so and when afterwards accosted said he would not admit or deny the offences. He was fined £2 for each offence.

China Clay Notes and News

China Clay Worker's Death

The death of Mr. Joseph Pascoe, which took place at Grove Terrace, Trenance, St. Austell, has evoked great sympathy with the bereaved widow and family. Mr. Pascoe was only 60 years of age and enjoyed robust health until recently, when he received hospital treatment for a carbuncle in the neck, and unfortunately internal complications set in. For more than a quarter of a century Mr. Pascoe resided at Blackpool, St. Austell, and was employed at the Biscovellett China Clay Works. He was keenly interested in politics.

A New China Clay Company

Beacon Clays, Ltd. Private company, registered March 13, Capital, £10,000 in £1 shares. Objects: To carry on the business of producers and manufacturers of and/or dealers in China Clay, china stone, ball clay, tiles, pipes, fencing post, building stone, bricks, etc. The first directors are E. J. Hancock, Bay House, St. Austell; E. H. Davison, 44, Mount Pleasant Road, Camborne; and M. Richards, Stenalees, St. Austell (all permanent subject to each holding 500 shares). Solicitors, Stephens, Graham, Wright and Co., St. Austell.

Fowey's Increased China Clay Tonnage

Increased exports have been a feature of the China Clay trade in the last two months. Fowey was responsible for dealing with nearly the whole of the increased tonnage. In February, 1926, Fowey exported 66,422 tons of China Clay against 53,880 tons for February, 1925, the tonnage from the county for February, 1926, being 81,311 against 66,986 for February, 1925, thus showing that Fowey exported over 81 per cent. of the total. The Harbour Commissioners are still catering for the entrance of the large ships by dredging the Harbour, and the G.W.R. are carrying out extensive repairs and alterations to the jetties.

An Opinion on Georgian Clay

It will be recalled that at the end of last year we published a statement from a Washington source regarding some kaolin properties purchased in Georgia. We have since received a sample of the clays and, with a desire to pass on to producers an accurate description of their properties, we have submitted the sample to a prominent London user of China Clay who has had, incidentally, some years' experience in the St. Austell district. His verdict is that the clay is of a poor colour, gritty, and containing some particles of mica. He considers that this product would compare only with the lower grade and ball clays of Cornwall. Given good transport facilities and low charges, the clay might prove a serious competitor to comparative Cornish grades in America, but not elsewhere.

Local Residents Benefit under Wills

Mr. Josiah Knight, of "Menedew," Luxulyan, near St. Austell, yeoman, who had also China Clay interests, who died on October 13, 1925, left estate of the gross value of £44,677, with net personalty £37,581. The testator left £3,000 to each of his daughters, Ruby Rundler, and Daisy Kathleen Knight, £1,600 to his daughter Lilian Jane Box, £1,000 to his daughter Claudine Solomon Lyne, £50 to each grandchild attaining majority, the premises known as "Lower Gurtla," Luxulyan, to his son Clarence, all other his real estate in Luxulyan and Withiel to his son Norman, and the residue of his property to his said two sons in equal shares.

Mr. Frederick Stephens, of Penawyn, St. Dennis, farmer and China Clay haulier, who died on December 23, 1925, left estate of the gross value of £7,819, with net personalty £7,534. The testator left £25 to Mr. Graham, to his wife an annuity of £25 charged on premises situated at Hendra Prazey which he left to his son Frederick Cuthbert and his children, £500 to his daughter Winifred Candelin, £500 to his daughter Fanny Olga Best, £300 and 400 ordinary £1 shares in English China Clays, Ltd., in trust for his daughter Bessie Rail, £100 and 400 like shares in trust for his daughter Susan Florence Stephens, his residence and furniture upon trusts for his wife and his daughter Susan, with ultimate remainder to his son Frederick, and to this said son he left the residue of his property.

Death of Veteran China Clay "Captain"

The death took place last month of "Captain" S. Minear, of Stenalees, St. Austell, at the age of 66 years. He had spent practically all his life in the China Clay works and was well-known as a China Clay "Captain." For several years he had been works manager for Shilton China Clay Works, and was so employed at the time of his last long illness. A tribute in the *Treverbyn Parish Magazine*, by the Rev. Hugh J. Sweeney, reads: "We have just laid to rest the remains of one who has had a long and honoured connection with Treverbyn Church. Samuel Minear, lately Vicar's Warden, for many years organist and choir trainer, loved and gave of his best to his parish church. Here was a man who put the Apostolic injunction 'while we have time let us do good unto all men' into practice, and the place is the poorer for his passing. Samuel Minear is another of those who, having helped to make Treverbyn Church a power for good and righteousness, have passed into a well-earned rest. As indicative of his love for the House of God here we have his splendid gift left by will of £100 to provide new oak choir stalls."

Burthy China Clay Co., Ltd.

Burthy China Clays, Ltd., is a private company, registered March 26, with a capital of £15,000 in £1 shares. Its objects are to acquire the business of China Clay merchants, quarrymen, producers and manufacturers of and dealers in china stone, buildings and road stone, dressed and cut stone, and other metals and products, and shippers, contractors, carriers and hauliers, heretofore carried on as "The Burthy China Clay Co." (the managing partners whereof were Sydney B. Perry and Archibald Perry, styling themselves as "Perry Brothers"), at Burthy Clay Works, St. Enoder and St. Austell, and elsewhere in Cornwall. The first directors are S. B. Perry, Penvale, St. Austell; A. J. Perry, Beech Road, St. Austell; H. D. Kenyon, Mount Charles, St. Austell; W. Phillips, Trewoon, St. Austell; S. J. Dyer, King's Avenue, St. Austell; S. H. Pedlar, Ruthern, near Bodmin (all permanent subject to each holding £300 shares). The two first named are managing directors and works managers. Remuneration £25 each per annum. Secretary, A. J. Perry; Solicitor, J. M. Bennetts, Truro; Registered office, Y.M.C.A. Buildings, St. Austell, Cornwall.

China Clay Firm in Liquidation

In the compulsory liquidation of William Adolph and Co., Ltd., exporters of China Clay, etc., 135, Upper Thames Street, London, E.C., the Official Receiver has now issued his report to the creditors and the shareholders, together with a summary of the company's statement of affairs. This discloses liabilities of £16,711, of which £16,080 are returned as due to thirty-three unsecured creditors, £130 as preferential, payable in full, and £500 as the debenture holders' claim, payable as to £127 in full, making the ranking liabilities £16,453. The assets are estimated to realise £257, and are absorbed in the payment of the preferential claim and the part payment of that of the debenture holder. The assets chiefly consist of good book debts and furniture and fittings, the following items being returned as valueless: bad book debts, £1,631; Russian debts, £1,816 (net); and Russian bills of exchange, £2,787. With reference to the shareholders, the statement shows a total deficiency of £22,755.

In his report on the liquidation, the Official Receiver observes that the company was incorporated in June, 1914, with a nominal capital of £10,000 in £1 shares, and was formed to take over the business formerly carried on by Albert Joseph Adolph. The issued shares are all held by members of the family. The failure of the company is attributed by J. A. Adolph primarily to the loss of its Russian trade, and inability to obtain payment of the debts due from its Russian customers, to bad debts and losses on foreign exchange, also to the general depression in trade during recent years, and to the unstable financial position of European countries, owing to which, he states, the company was unable to obtain sufficient business to produce profits. In the opinion of the Official Receiver the failure has been contributed to by the payment of remuneration to directors out of all proportion to the amount of trade done. The company has been insolvent since 1917. The liquidation remains in the Official Receiver's hands.

Fowey Regatta Dates Altered

Because the Port of Plymouth Regatta Committee have cancelled the date allotted to them by the Y.R.A., and have annexed the date previously advertised by the Royal Fowey Yacht Club, it has been decided to hold the Fowey Regattas in the week commencing Monday, August 16. The programme will be: August 16, Channel race from Plymouth and Falmouth; August 17, Royal Fowey Yacht Club Regatta. Fowey Royal Regatta will probably be held on Wednesday, August 18, followed by a Channel race from Fowey to Plymouth or Falmouth on August 19.

Death of Mrs. H. Hancock

At "The Glen," Carclaze, St. Austell, in the house where she had lived for nearly 50 years, and where five of her six children were born, Mrs. Hannah Hancock, widow of Mr. Edwin George Hancock, and mother of Mr. E. J. Hancock, China Clay merchant, passed away last month, aged 75. She had been in failing health ever since the death of her husband, eleven months ago, but was confined to her bed only for about two weeks. For over 50 years she was a regular worshipper at the Carclaze U.M. Church, and was highly esteemed by all who knew her.

Road to Charlestown Port Classified

At the last meeting of the St. Austell Urban Council great satisfaction was expressed on the receipt of a letter from the Ministry of Transport intimating that they had decided to classify the road leading to the China Clay port of Charlestown as a class 1 road, which means that half the cost of its upkeep will be borne by the Ministry of Transport. Councillor T. J. Smith, in welcoming the announcement, said that a good deal of credit for that result was due to the surveyor, Mr. E. D. Groves, for putting the case for its classification so well to the Ministry. It would result in an enormous saving to that area. Councillor Mutton endorsed this opinion.

New District Rates

At a meeting of the St. Austell Urban Council held at the end of March, Councillor Rowett submitted the Finance Committee's report recommending a general district rate for the ensuing half-year of 3s. 2d. in the £, and a water rate of 6d. He pointed out that this was an increase in each case of 2d. on the previous half-year. He explained that the extra cost for improving the roads involved something like £500. Provision was made in the estimates for the public conveniences proposed at Charlestown. They were endeavouring to keep the rates down, but they must bear in mind that improvements cost money, and while the increased rateable value would help to meet the extra cost they could not contemplate lower rates yet. The report was adopted.

China Clay in Paper Making

We publish this month a practical article by a leading paper maker, and the indications of the requirements of that industry (which is such a large buyer of China Clay) should prove helpful to producers. In conversation with the writer he pointed out that while the choice of clays for paper making will always be influenced by the specific requirements and preferences of each firm, yet the general tendency is towards the use of finer clays than have always been utilised in the past. Machines to-day turn out some 750 ft. of paper a minute and the clay fed into the plant will naturally seriously hamper smooth working if it contains any foreign matter in the form of grit, or even grains of coarser clay. It was this manufacturer's opinion that the future for fine clays is particularly bright in the paper industry.

Death in China Clay Works

St. Austell and Roche districts heard with much regret of the sudden collapse while at work and subsequent death of "Captain" Richard Payne, for he was well-known there. He died at work at Carn Stents China Clay Works, near St. Austell, recently. The body was taken to his home at 15, Grove Terrace, Trenance, St. Austell, where an inquiry was held by the County Coroner (Mr. M. F. Edyvean) on the following Saturday. After the medical evidence of Dr. R. S. Olver, the jury arrived at a unanimous verdict of "Death from Heart Failure."

"Captain" Payne was a native of Roche, and was a son of the late Mr. and Mrs. Joseph Payne of Trezaise. He had been associated with the China Clay industry for more than half a century, formerly at West Goonbarrow, and for a period of 25 years he was superintendent of the Greensplatt China Clay Works for John Higman and Co., the well-known producing firm, at St. Austell, and for the past 16 years "Captain" Payne had been engaged in a similar capacity at the Carn Stents China Clay Works for Payne and Tellam, proprietors.

"Captain" Payne's Religious Activities

Throughout his life "Captain" Payne was a loyal and liberal son of the former Bible Christian Denomination and the United Methodist Church, and in the many activities of Trezaise Chapel he exercised much influence for good. He was not only a trustee but a devoted organist for 20 years, and leader of the Bible class. During his residence at St. Austell, "Captain" Payne was identified with Zion United Methodist Church, and by all with whom he came into contact, whether commercially or religiously, he was found to be a man of sterling character.

The interment took place in St. Austell Cemetery on Easter Monday afternoon. Testimony to his splendid service in the cause which came so near his heart was evidenced by the large and representative attendance at the funeral. The bearers were: "Captain" W. B. Arthur, "Captain" E. Hawke, Messrs. W. Higman, G. Tippett, W. Common, and J. Dyer (colleagues from the Trezaise Chapel). Among those present were Mr. A. Tellam and Mr. S. Mullis (representing the proprietors of the Carn Stents China Clay Co.), and representing the employees, "Captain" V. Hooper and "Captain" M. Rabey.

St. Austell Golf Club's Progress

At a recent special meeting of the members of the St. Austell Golf Club, Mr. John Lovering (of John Lovering and Co.) was cordially welcomed on his acceptance of the position of president of the Club, which is just entering upon an era of prosperity following the acquisition of the links and its formation into a limited company. The majority of the members are engaged directly or indirectly in the China Clay industry.

A very gratifying report of the response from members in support of the new financial scheme, which includes the acquisition of the freehold of the links, was given by Mr. J. Keay, secretary of the special committee which has been carrying out negotiations. The funds provided by the members were such as to warrant the committee proceeding with the arrangement to purchase the links, a step that was cordially agreed to. At the same time, as a part of the scheme, there is the formation of the Club into a private limited liability company. The outline of this scheme, as explained by Mr. Keay, was approved by the meeting, giving power to the general committee of the Club to transfer the assets to the company as soon as the formalities were completed.

From the year 1910, when the St. Austell Golf Club was formed, it has been a private members' club, with an annually elected executive. During a period of 13 years the land has been held by the Club under a lease, which becomes terminable at no very distant date. Apart from this unsatisfactory leasing, no less than four of the eight original lessees have died, or can no longer be considered as lessees, leaving an additional responsibility on the remainder. For a long time that state of affairs has been considered by many to be undesirable. In 1918 an unsuccessful attempt was made to purchase the freehold of the land, and from that time the committee of management have again and again approached the land owner with a view to purchase, and have now been successful.

Mr. John Lovering, the newly-elected president, was welcomed on behalf of the committee by Mr. J. B. King, the honorary secretary; and Mr. A. Davies, club captain, expressed his pleasure at Mr. Lovering's acceptance of office, which had been held by Mr. D. H. Shilson from the time of the Club's formation. The permanent officials are: President: Mr. J. Lovering; Vice-presidents, Sir Francis Layland Barratt, Major A. P. Coode, Mr. H. W. Higman, Mr. W. Kendall King, Mr. G. T. Petherick, Admiral Sir Charles Graves-Sawle, Mr. T. Medland Stocker, and Mr. H. Stocker.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—March, 1926

Arrivals

Date.	Vessel.	From
March 1	*Torpoint*	Cardiff
March 1	*Daisy*	Barry Dock
March 2	*Coaster*	Dartmouth
March 5	*Porthcarrach*	Plymouth
March 12	*Foamville*	Guernsey
March 15	*Katie*	Par
March 16	*Treleigh*	Portreath
March 17	*Dunmore*	Southampton
March 17	*Florence*	Plymouth
March 17	*Orenie*	Cardiff
March 19	*Windermere*	Newport
March 20	*Oceanide*	Penzance
March 28	*Magrix*	Barry Dock
March 28	*Alert*	Truro
March 28	*Elizabetta*	Padstow
March 29	*Lady Daphne*	Truro
March 29	*Jane Barks*	Falmouth
March 29	*Porthcarrach*	Plymouth
March 31	*Guardian*	Kingsbridge
March 31	*Ortona*	Newlyn

Sailings

Date.	Vessel.	Destination.
March 3	*Duchess*	Runcorn
March 3	*Porthleven*	London
March 4	*Coaster*	London
March 6	*Porthcarrach*	Larne
March 13	*Foamville*	Runcorn
March 17	*Treleigh*	Preston
March 17	*Katie*	London
March 18	*Florence*	Liverpool
March 18	*Dunmore*	London
March 28	*Windermere*	Rochester
March 28	*Oceanide*	Granville
March 30	*Alert*	London
March 30	*Elizabetta*	Larne (Ireland)
March 31	*Magrix*	London
March 31	*Porthcarrach*	Brussels

Fowey Shipping—March, 1926

Arrived.	Name.	Sailed	Destination
February 1, S.S.	*Ravenspoint*	February 3,	Genoa
February 1, S.S.	*Lisa*	February 6,	Newcastle
February 2, S.S.	*Cambalu*	February 3,	Liverpool
February 2, M.V.	*Hope*	February 5,	Pentewan
February 2, M.V.	*Monsun*	February 6,	Sarpsborg
February 3, S.S.	*Ferndene*	February 5,	Antwerp
February 3, S.S.	*Harlaw Plain*	February 6,	Rochester
February 3, S.S.	*Orchis*	February 6,	Ridham
February 5, S.S.	*Gronant Rose*	February 9,	Runcorn
February 5, M.V.	*Jantje Grunefeld*	February 9,	Harburg
February 5, S.S.	*Primrose*	February 9,	Newlyn
February 5, S.S.	*Dicky*	February 10,	Bilbao
February 5, S.S.	*Horn*	February 10,	Bilbao
February 6, S.S.	*Eda*	February 10,	Portland, Me.
February 6, S.V.	*W. E. Gladstone*	February 10,	Pentevan
February 6, M.V.	*Lydia Cardell*	February 12,	Rouen
February 7, S.S.	*Mersey*	February 12,	Ridham
February 7, S.S.	*Manchester Civilian*	February 13,	Portland, Me.
February 7, S.S.	*Haig Rose*	February 11,	Weston Point
February 7, S.S.	*Ambleside*	February 11,	Brussels
February 8, S.S.	*Waterway*	February 11,	Antwerp
February 8, M.V.	*Hope*	February 9,	Plymouth
February 9, S.S.	*Falmouth Castle*	February 11,	Runcorn
February 9, S.S.	*Joffre Rose*	February 13,	Preston
February 9, S.S.	*Onyx*	February 13,	Antwerp
February 10, S.S.	*Herold*	February 21,	Philadelphia
February 10, S.S.	*Dorset Coast*	February 11,	Liverpool
February 10, S.S.	*Pamela*	February 13,	Newcastle
February 11, S.S.	*Edenside*	February 13,	Kirkcaldy
February 11, S.S.	*Svenske*	February 16,	Grangemouth
February 11, S.S.	*Mercurius*	February 16,	Karlskrona
February 11, S.S.	*Shoreham*	February 17,	Runcorn
February 11, S.S.	*Scartho*	February 17,	Drammen
February 11, S.S.	*Ribblebank*	February 13,	Liverpool
February 12, S.S.	*Monkstone*	February 18,	Antwerp
February 13, S.S.	*Guelder Rose*	February 18,	Rouen
February 13, S.S.	*Crofter*	February 18,	Rouen
February 13, M.V.	*Henrich Luhring*	February 17,	Hamburg
February 16, S.S.	*Odda*	February 20,	Antwerp
February 16, S.S.	*Westlea*	February 20,	Baltimore
February 16, M.V.	*Eldorado*	*	
February 16, S.S.	*Tirydail*	February 19,	Brussels
February 16, S.S.	*Katherine*	February 17,	Plymouth
February 16, S.S.	*Westdale*	February 19,	Liverpool
February 16, S.S.	*Cornwall*	February 31,	Granton
February 18, S.S.	*Rossmore*	February 19,	Bo'ness
February 18, S.S.	*Martin Nisson*	April 4,	Drammen
February 18, S.S.	*Horn*	March 20,	Pasages
February 18, S.S.	*Gouwestroom*	March 25,	Amsterdam
February 19, S.S.	*Joffre Rose*	March 22,	Aberdeen
February 19, S.S.	*Farfield*	March 22,	Fleetwood
February 19, S,S.	*Harwich*	March 30,	Poole
February 19, S.S.	*Seaforth*	March 20,	Rouen
February 20, S.S.	*Southwell*	March 24,	La Pallice
February 22, S.S.	*Fellside*	March 26,	Brussels
February 22, M.V.	*Laanemaa*	March 27,	Brussels
February 22, S.S.	*Blairatholl*	March 31,	Portland, Me.
February 23, S.S.	*Gronant Rose*	March 25,	Runcorn
February 23, S.S.	*Falmouth Castle*	March 22,	Runcorn
February 24, S.S.	*T. P. Tilling*	March 27,	Preston
February 24, S.S.	*Hosianna*	April 7,	London
February 24, S.S.	*Overton*	March 25,	Liverpool
February 24, S.S.	*Naples Maru*	*	Philadelphia
February 24, S.S.	*Hornland*	March 30,	Genoa
February 25, S.S.	*Wheatplain*	March 27,	Bristol
February 25, S.S.	*Foch Rose*	March 31,	Preston
February 25, S.S.	*Mary Ann*	*	
February 25, S.S.	*Alice Williams*	*	
February 25, S.S.	*Brier Rose*	March 27,	Garston
February 26, S.S.	*Magrix*	March 28,	Pentewan
February 26, S.S.	*Ferndene*	April 1,	Antwerp
February 26, M.V.	*Mary Ann Mandall*	April 7,	Rochester
February 26, M.V.	*Jane Banks*	March 30,	Charlestown
February 27, M.V.	*Wigala*	March 31,	Harburg
February 30, M.V.	*Jantine Fennigine*	April 1,	Gravelines
February 30, S.S.	*Falmouth Castle*	March 31,	Runcorn
February 30, S.S.	*Knowl Grove*	March 31,	Gravesend
February 30, S.S.	*Glasgow Maru*	*	Philadelphia

*Signifies "In Port."

Par Harbour Shipping—March, 1926

Sailings

Date.	Vessel.	Destination
March 1, S.S.	*Fernside*	Leith
March 2, S.V.	*Western Lass*	Glasgow
March 3, S.S.	*Treleigh*	Preston
March 3, S.S.	*Daisy*	Porthoustock
March 4, S.S.	*Magrix*	Gravesend
March 4, S.V.	*Snowflake*	Weston Point
March 5, S.S.	*Robrix*	Gravesend
March 5, S.S.	*Torpoint*	Penarth
March 15, S.V.	*Pearl*	Liverpool
March 15, M.V.	*Katie*	Charlestown
March 16, S.S.	*Cornish Merchant*	Falmouth
March 17, M.V.	*Kate*	Gloucester
March 17, S.V.	*Pedestrian*	Rochester
March 18, S.V.	*Gauntlet*	Rochester
March 18, S.V.	*Two Sisters*	Falmouth
March 19, M.V.	*Kendingen*	Greenhithe
March 19, S.S.	*Farfield*	Fleetwood
March 19, S.S.	*Seaforth*	Rouen
March 24, M.V.	*Hope*	Pentewan
March 27, M.V.	*Leeuwerik*	Liverpool
March 27, M.V.	*Gazelle*	Frederickshall
March 30, S.S.	*Velocity*	Newlyn
March 31, S.S.	*Tanny*	Penarth

Arrivals

Date.	Vessel.	From
March 3, S.S.	*Magrix*	Teignmouth
March 3, S.S.	*Daisy*	Charlestown
March 3, S.S.	*Robrix*	Truro
March 4, S.S.	*Torpoint*	Looe
March 10, S.V.	*Pearl*	Porthoustock
March 11, S.V.	*Gauntlett*	Falmouth
March 11, M.V.	*Kate*	Truro
March 13, S.S.	*Cornish Merchant*	Newport
March 13, M.V.	*Kendingen*	Blyth

March 14,	M.V. *Hope*	Porthoustock
March 16,	M.V. *Leeuwerik*	Goole
March 16,	S.S. *Farfield*	Littlehampton
March 16,	S.S. *Seaforth*	Kingsbridge
March 19,	M.V. *Anniemarie*	London
March 25,	M.V. *Gazelle*	Poole
March 28,	S.S. *Velocity*	Newport
March 28,	S.S. *Tanny*	Newlyn
March 28,	M.V. *Cornelia*	Exeter
March 28,	S.S. *Birmingham*	Garston
March 29,	M.V. *Ilse*	Duarnenez
March 30,	S.V. *Hilda*	Newlyn
March 30,	S.V. *J.N.R.*	Porthoustock
March 30,	S.V. *Guiding Star*	Falmouth

Par Harbour Tide Table, May, 1926

(*British Summer Time Throughout.*)

Day of Week.		Morning.	Afternoon.	Height.
Saturday	1	8.22	8.40	12.9
Sunday	2	8.59	9.19	12.3
Monday	3	9.40	10.2	11.7
Tuesday	4	10.29	10.58	10.10
Wednesday	5	11.31	—	10.4
Thursday	6	0.9	0.51	10.3
Friday	7	1.35	2.17	10.9
Saturday	8	2.55	3.29	11.8
Sunday	9	3.59	4.27	12.6
Monday	10	4.53	5.18	13.2
Tuesday	11	5.42	6.5	13.6
Wednesday	12	6.27	6.48	13.6
Thursday	13	7.9	7.29	13.5
Friday	14	7.48	8.6	13.0
Saturday	15	8.24	8.42	12.5
Sunday	16	9.1	9.19	11.8
Monday	17	9.38	9.58	10.11
Tuesday	18	10.19	10.42	10.2
Wednesday	19	11.8	11.37	9.7
Thursday	20	—	0.10	9.3
Friday	21	0.46	1.23	9.5
Saturday	22	1.59	2.33	10.0
Sunday	23	3.5	3.34	10.9
Monday	24	4.0	4.24	11.5
Tuesday	25	4.46	5.7	12.1
Wednesday	26	5.27	5.47	12.7
Thursday	27	6.6	6.26	12.11
Friday	28	6.47	7.8	13.0
Saturday	29	7.28	7.47	13.0
Sunday	30	8.6	8.26	12.9
Monday	31	8.48	9.11	12.5

E. CLEMENS, Harbour Master.

March Deliveries Down

BEARING in mind the fact that there were three fewer working days in March than February, the falling off in the total turnover in the three classes of materials (China Clay, China Stone, and ball clay) was greater in comparison than the actual 105 tons difference between the totals of March and February. Compared with the corresponding month last year, the drop is considerable—12,648 tons—but when it is borne in mind that the total in March last year —98,598 tons—was the biggest monthly total in 1925, this is not so discouraging as at first appears.

The total for the three months compared with the corresponding three months last year is down by 6,108 tons, but comparing it with the total trade last year—959,372 tons—the average for the three months is 4,729 tons above the quarterly average last year. Thus the upward tendency in the volume of trade experienced last year is well maintained. Here are the details for March :—

	China Clay. Tons.		China Stone. Tons.		Ball Clay. Tons.		Total Tons.	
Port	1926	1925	1926	1925	1926	1925	1926	1925
Fowey	63,573	74,455	4,983	2,526	1,224	1,825	69,780	78,806
Charlestown	4,167	4,287	—	—	—	—	4,167	4,287
Par	3,559	4,606	350	—	—	—	3,909	4,606
Plymouth	2,674	1,670	—	—	—	30	2,674	1,700
Penzance	335	3,721	—	—	—	—	335	3,721
Falmouth	183	180	—	—	—	—	183	180
Newham	158	—	—	—	—	—	158	—
Looe	—	150	—	—	—	—	—	150
By rail	4,744	5,148	—	—	—	—	4,744	5,148
Totals	79,393	94,217	5,333	2,526	1,224	1,855	85,950	98,598
February	81,331	66,986	3,166	3,436	1,558	614	86,055	71,036
January	66,520	75,490	3,742	2,506	3,156	3,050	72,567	81,046
3 months	227,244	236,693	12,241	8,468	5,938	5,519	244,572	250,680

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ADAMS PICT FIRE BRICK CO., LTD., Newcastle-on-Tyne.—Registered March 10, £9,500 mortgage, to H. Eskdale, Swalwell, firebrick manufacturer; charged on property at or near Swalwell.

ANGLESEY BRICK AND TILE CO., LTD., Llanbedr.—Registered March 2, £4,000 debentures; general charge.

BAKER AND CO., LTD., Stoke-on-Trent, earthenware manufacturers.—Registered March 17, £3,300 mortgage or charge (supplemental to mortgage dated June 14, 1919) to Leek and Moorlands Building Society; charged on property at Fenton. *£4,250. December 31, 1925.

ST. CUTHBERTS PAPER WORKS, LTD. (late PIRIE WYATT AND CO., LTD.), London, E.C.—Registered March 23, debenture to Bank; charged on properties specified in schedule, also general charge (subject to certain existing charges). *£50,000. March 23, 1925.

Satisfaction

MAW AND CO., LTD., London, E.C., tile manufacturers.—Satisfactions registered March 8, £10,900, part of £13,000, registered December 23, 1910; £50,400, total amount issued under Trust Deeds registered December 29, 1919, and May 6, 1922; and £5,900 and premiums, total amount issued under Trust Deed registered May 19, 1922.

China Clay Exports for March, 1926

A RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom from the United Kingdom to each country of destination registered during the month ended March 31, 1926.

Country of Destination.	Quantity. Tons.	Value. £
Estonia	11	36
Sweden	889	2,205
Norway	2,644	3,365
Denmark	1	8
Germany	2,058	4,746
Netherlands	2,316	4,655
Belgium	5,972	9,527
France	4,723	7,598
Portugal	121	273
Spain	1,553	3,616
Italy	2,822	7,175
Greece	10	60
Turkey Asiatic	11	55
China	1	10
United States of America	30,803	63,608
Brazil	25	106
Cape of Good Hope	—	1
Transvaal	—	1
Bombay, via other Ports	1,144	4,801
Madras	78	347
Bengal	150	489
Australia	45	246
Canada	125	148
Irish Free State	5	3
Total	55,507	113,079

China Clay Imports for March, 1926

A RETURN showing the registered imports of China Clay, including China Stone, into Great Britain and Northern Ireland during the month of March, 1926, gives two entries, one from Germany of 12 tons valued at £62, and the other from the Channel Islands of 210 tons valued at £357—a total tonnage of 222 and a total value of £419.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

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The Strike and its Effects

As is usual in times of national crisis, the General Strike, so far as the withdrawal of labour was concerned, was less felt in Cornwall than in any other part of the country, partly because Cornwall is remote from the great centres of population and less under the influence of mass thinking and irresponsible agitators, and partly because the workers in Cornwall think for themselves and place loyalty to their employers before the unconsidered dictation of trade union leaders. Hence, when the General Strike call came, not a single China Clay worker left work, all of them were loyal to their employers and considered that the dispute over the miners' question was no direct concern of theirs. The China Clay proprietors, on their part, in appreciation of the loyalty with which their employees stood by them, determined from the outset of the strike to maintain them in full employment as long as possible, and then to reduce their hours slightly when accumulation of stocks compelled them to suspend production operations. Happily the strike was over before it was necessary to introduce these restrictive measures to any appreciable extent.

Had it not been for the suspension of the transport of China Clay by rail and the withdrawal of the 200 or so jetty men at the G.W.R. jetties at Fowey, it would have been possible to carry on the China Clay industry normally, as the shipment of China Clay was carried on by the dockers at Charlestown throughout the strike, and at Par after the first five days. In the eight days the shipment of upwards of 24,000 tons was missed from Fowey, through the suspension of work at the jetties, there having been four or five big ocean-going steamers for cargoes to America, and a large number of small steamers and schooners for cargoes to continental ports loading and ready for berths when the strike order was obeyed. The s.s. *Sittang* left with her cargo of 7,000 tons for America, being towed out by a French tug from Cherbourg, and one or two other vessels left with part cargoes. One American steamer in for 6,000 tons left light.

Loss Retrievable

Apart from the loss of something like £1,000 in wages to the jetty men and several hundreds more loss to the railwaymen engaged on the traffic from the works to Fowey, the loss in wages to the China Clay workers by the failure to ship the tonnage referred to, represents between £10,000 and £12,000, as the average wages costs of every ton of clay is about 10s. The loss to the industry through the failure to execute the orders at the time, calculating the tonnage at an average of 30s., represents approximately £35,000 gross. It is the opinion of the China Clay producers that irreparable harm will not be done to the industry's overseas markets, which, it must be borne in mind, represent over two-thirds of the industry's total trade—if the loading at Fowey is speeded up, so that the held-up tonnage is disposed of, and the time lost overtaken by the working of continuous shifts. In that way the jetty men would recoup themselves their loss, but, far more important, the innocent victims of their action—the China Clay workers—would be insured against any limitation of the normal employment through the congestion at the works hindering production operations, and the producers would suffer no loss in tonnage on the year, and would be able to appease their customers.

Pacifying Overseas Customers

This is the means proposed by the China Clay producers for minimising as much as possible the effects of the strike on the industry, and to repair any injury done to its overseas markets that were in danger of being captured by foreign competitors. Happily, the strike was not prolonged enough for consumers to feel the need of alternative supplies, though there was considerable danger of some important overseas markets being jeopardised. With the efforts the China Clay producers are making by the speeding up of deliveries, hindered by the strike, consumers in both home and overseas markets are assured that the execution of their orders will not be delayed to an extent likely to cause them serious inconvenience. It is some consolation and a source of satisfaction to the industry to recall that it was the victim of completely outside influences, and that neither the producers nor their employees were parties to the interruption of its normal operations.

Tehidy Minerals

Elsewhere in this issue is reported the general meeting of Tehidy Minerals, Ltd. The financial side and prospects, as at present indicated, justified an optimistic outlook on the part of those in control. That is satisfactory, but much must depend upon the proposed new association of producers, for the report says the profit from medium and common clays has decreased since the collapse of the old association. It may seem unnecessary to point continually to the effects of that unwelcome happening and to stress the considerable setback to prosperity that it entailed. But, only by the realisation of these concrete effects by each and every potential member of the new association can a repetition of that collapse be averted.

The Need for Enterprise

We offer no comment or qualification upon the following views expressed to us recently by a prominent member of the paper trade and one who was for many years actively acquainted with the St. Austell area as a resident. He complained that the industry and people as a whole are too self-contained and in a sense too self-satisfied. His point was that while many of the families had worked for generations in the China Clay industry, they resented innovations or any outside suggestions as quite unnecessary and unworthy of consideration. While many of the leading firms are now commendable examples of enterprise, yet this critic's arguments may not be altogether inapplicable to certain "inherited" processes.

Another complaint was the ignorance of certain classes of labour as to the ultimate uses of their product. This state, he maintained, was unworthy of the industry and could create an undesirable impression among prospective purchasers. As we have said, we offer no comment upon these criticisms, but merely reproduce them as coming from one who, by his very connection with the paper trade, has still intimate interests with the China Clay area.

Tehidy Minerals' Prospects

Directors' Guarantees Revealed

THE sixth ordinary general meeting of shareholders in Tehidy Minerals, Ltd., was held at the registered office of the company at Camborne, Mr. C. V. Thomas, director, presiding.

The chairman regretted the absence of Sir H. Montagu Rogers, chairman of directors, who was confined to bed with a chill. He expressed their regret at Sir Montagu's indisposition, and their congratulations on the knighthood conferred upon him since their last meeting. Fortunately, Sir Montagu had prepared the speech he had intended to deliver at that meeting, and had asked him, Mr. Thomas, to read it.

In comparing both the profit and loss account and the balance sheet with those for 1924, it was essential to remember that they disposed of the Halviggan Clay Works as from December 1, 1924, and therefore any sales of clay and expenditure in connection with the clay pits would not appear in the 1925 accounts. All the items on the debit side of the profit and loss account, with the exception of a small addition for accountancy, were considerably less than for 1924. The total received from mineral dues and rents amounted to £15,464 1s. 2d.—an increase of £3,184 8s. 7d., being an increased profit of £3,293 11s. 1d. By the articles of association the directors were entitled to a commission on sales. The auditors certified that a small sum was due to them, but they had decided to forgo any sum to which they were entitled up to the end of 1925.

Halviggan China Clay Works

At the end of 1924, the loan account stood at £20,000. During 1925, £15,000 of this sum was repaid, leaving a balance of £5,000 due at December 31, 1925. "But during the current year the £5,000 has been paid off and the company is now free from any loan or charge. Now that we are once more in this happy position, I think you should know something of the difficulties we experienced in raising the money necessary to carry on the company during the difficult slump period in 1921, and which I have hitherto refrained from mentioning. To enable us to pay for the Halviggan works we had to raise funds by the issue of debentures. We borrowed £25,000 from a private source on the first debenture and the balance required from the bank. To obtain such balance Mr. C. V. Thomas voluntarily became guarantor to the bank for £5,000. In June, 1923, the first debenture fell, and the bank offered to come to the rescue on condition that your directors gave guarantees for the £25,000, and the late Mr. Wethered and Mr. C. V. Thomas joined with myself in giving such guarantees. I do not think it is any part of a director's duty to accept such a heavy personal responsibility on behalf of a public company, but in this instance it was done as an act of loyalty to the shareholders. It certainly saved the company a large amount in interest.

Year's Profit over £10,000

"The profit for the year amounted to £10,744 19s. 7d., to which must be added the balance brought forward from the year 1924, making a total of £12,554 15s. 2d., less £110 for Corporation Profits tax (now abolished), leaving a credit balance of £12,444 15s. 2d. From this balance we have decided to write off £1,586 5s. 10d., the balance of the preliminary expenses, leaving a credit balance of £10,858 9s. 4d., which the directors recommend should be carried forward to the current year. Your directors consider the result satisfactory. It has been brought about by an increasing revenue and diminished expenditure." In order to pay off the remaining loan of £5,000 they had to encroach on their cash reserves. These would be gradually restored, which would enable them to pay a dividend, though moderate, before the current year was out, and perhaps be in a position to anticipate the end of the year by some months.

China Clay Position

"The consumption of China Clay," Sir Montagu's report continued, "is still in the ascendant, but I am afraid it must be admitted that profits from medium and common clays since the collapse of the old association have been on the down grade during 1925. Praiseworthy efforts are being made to form a new association to deal with these clays. Such efforts may be crowned with success if all the producers will submit to some restraint in order that all may profit by the organisation. I cannot but look forward to prosperity during the present year."

Mr. Thomas supported these remarks and moved the adoption of the report and accounts. Mr. F. A. Robinson seconded, and said that they were likely to receive a larger sum by way of dues—a sum more in accordance with the original expectations. Their expenses had been very much reduced. Comparing the expenditure of last year with that of 1920, the year before they purchased the China Clay works, there had been a reduction of 50 per cent.

Mr. Harvey moved a vote of thanks and appreciation to the directors upon the improved financial state and especially for the financial assistance revealed as rendered by the directors. Mr. W. J. Smith seconded and the resolution was carried unanimously. In reply, the chairman said that the outlook now was considerably improving. Expenditure had diminished, and the receipts would be steadily advancing.

Strike Effect in China Clay Area

Loyalty of Clay Workers

THE workers in the China Clay district did not respond to the general strike call, though some of them were members of the Workers' Union. So far as the machinery of the China Clay industry itself is concerned, the trade was in a position to continue its normal operations, there being ample stocks of coal and the workers remaining loyal to their employers. But the hold-up of transport and shipping facilities on the railways and at the port of Fowey quickly produced such congestion of stocks at the China Clay works that a severe restriction of employment was inevitable if the strike was prolonged. At the end of the first week of the strike, English China Clays, Ltd., the largest firm in the industry, issued a statement that their men would be kept fully employed for a further week and that the week after the days would be reduced by one hour, and in the following week by two hours. All the other firms are not so well placed as English China Clays, Ltd., and had to make a more severe cut in hours and number of men employed.

When the strike order was responded to on the Tuesday morning at the conclusion of the night shift at Fowey by the stevedores at the jetties, there were twenty-four vessels in the harbour awaiting cargoes of China Clay. Four or five were big ocean-going steamers engaged in the American trade, the others being small steamers and schooners. Two vessels—the *River Fisher* and *Primrose*—with part cargoes, managed to leave the harbour on the Tuesday. As the tugs that are employed to tow out the big ocean-going vessels ceased working, the captain of a big vessel, the s.s. *Sittang*, which was loaded with 7,000 tons of China Clay for America, was prepared to leave the harbour without the tug's assistance, but the attempt was not favoured by the owners. However, not to be frustrated in their ambition to get the cargo away, the owners chartered the services of a French tug from Cherbourg, and on the Thursday morning tugged the *Sittang* outside the mouth of the harbour. At Par Harbour work was resumed at the beginning of the second week.

After the first few days of the strike a restricted service of trains was run on the main line through St. Austell for goods and passenger traffic, in the second week a greatly extended service being put on. The St. Austell district has never been without a road motor service during the strike, services being run by the G.W.R. and the Cornwall Motor Transport, by some of their own men and volunteers. After three days a normal service was run. There have been few outside evidences of the strike, which has been confined to the railwaymen and the dockers at Fowey. But for their suspension of work, industrially the district would have been normal.

China Clay Crucibles Favoured

CHINA Clay crucibles, says the annual report of the National Physical Laboratory (Metallurgical Department), issued recently, containing 25 per cent. of alumina, previously calcined to 1,560° C., have been found satisfactory for chrome nickel alloy melts in the high-frequency induction furnace. Further, the work of this furnace requires the use of refractory sleeves for the purpose of retaining a layer of powdered refractory around the crucible proper. These have formerly been made of vitreous silica, but have now been replaced by carborundum/China Clay bodies, which are stronger and give more satisfactory service.

China Clay Notes and News

Fowey's Water Revenue

Fowey obtains a good deal of revenue in relief of the rates from water supplied to China Clay vessels. During February the receipts from this source amounted to £60 19s.

Falmouth Docks Secretary's Will

Mr. Robert George Borne, of 3, Wodehouse Terrace, Falmouth, secretary of the Falmouth Docks Company and chairman of the Harbour Board, left estate value £3,008, with net personalty £2,850. Probate of his will has been granted to his widow, Mrs. Emily Alice Borne, the sole executrix, of the same address.

Safeguarding the Pottery Industry

The British Pottery Manufacturers' Federation, on behalf of the china section of the British pottery industry, recently lodged with the President of the Board of Trade formal application for the setting up of a Committee of Inquiry, under the Safeguarding of Industries Act, with a view to the imposition of an import duty on foreign pottery wares.

Former St. Austell Stationmaster's Death

The many friends of Mr. Thomas Cobourne, who was for many years stationmaster at St. Austell, heard with regret of his death at Cheltenham, at the age of 61. He completed 46 years' service with the Great Western Railway two years ago, when he retired. During the whole time he was at St. Austell he won the esteem and respect of everyone who knew him. He had been ill about a month. He leaves a son and two daughters.

Master Mariner's Dog

Charles Price, master of the *Mary Ann*, a schooner at Fowey for a cargo of China Clay, was surprised to be charged with having a dog without a licence, that had strayed from his ship. He was fined 7s. 6d. for the offence. He was also fined 10s. for allowing the dog on the highway without the name and address of the owner on the collar. The captain was told that so long as the dog remained on board he was safe but when it got on shore he was liable.

Clayopolis Team Plays Everton

For the first time in the history of Cornish football, St. Austell team played a First Division team—Everton—last month and put up a first-rate fight, being beaten by only a couple of goals. They were subsequently entertained to dinner by the Supporters' Club, of which Mr. Walter Sessions (of English China Clays, Ltd.) is president. He said that as an old footballer it had given him the greatest pleasure to see the game that day. He thought their own boys were very sporty to tackle the professionals.

Prince of Wales and Local Housing

Much satisfaction is felt in the St. Austell district at the way in which the Duke of Cornwall (the Prince of Wales), through his Duchy Office, has met the St. Austell Urban Council by the sale of an admirable building site of about 15 acres at Polkyth, within the urban area, for £3,500. The original figure of £4,400 was well below the market value of the land, but having regard to the fact that the Council wanted it for the erection of between 150 and 200 houses for the working classes, the price was reduced to the figure stated.

Falmouth's China Clay Trade

"There is no doubt the shipping trade at Falmouth is improving," said Alderman A. W. Chard, presiding at a meeting of Falmouth Harbour Board last month. The western breakwater was being, he said, extended at the rate of a foot a day. It was reported that during March 84 steamers arrived, their tonnage being 106,990. Twenty-one were for bunkers, 18 for orders, and 34 to discharge and load. The new light buoys would be in position by April 21. In addition to the China Clay coming back, German steamers were calling for explosives. The receipts for the past quarter totalled £347 16s. 10d., as against £360 in the corresponding quarter of last year.

Heavy Traffic Between Par and Fowey

The County Surveyor, Mr. E. H. Colcutt, to the Main Roads Committee, on Friday, reported that considerable damage was caused to several portions of the main roads where heavy traffic was occurring, particularly on the Truro-Tregoney and Fowey-Par roads. Wet weather and heavy lorry traffic carrying building materials to houses being erected at Fowey caused the road to become almost impassable in places. He had done his best to eke enough money out of maintenance to patch it up temporarily, but in the year's estimate he had allowed for only 800 tons of stone, which would not enable more than a quarter of the length to be dealt with satisfactorily. Within the limits of expenditure he could not allocate more money to this road, so that there was no doubt it would be in a very poor condition until further funds were available.

China Clay Association Progress

There has been a further very representative meeting of China Clay producers at St. Austell in pursuit of the proposal to form another association to embrace all sections of the industry. The Lord-Lieutenant of Cornwall (Mr. J. C. Williams) again presided. The committee who had waited upon the best clays association presented their report, which was very satisfactory to the meeting. Tentative approval was given to a number of recommendations made by the committee as a basis for a new organisation, in which the best clays association intimated their willingness to join on certain conditions, which were acceptable to the meeting. The committee were authorised to pursue their work on lines approved by the meeting, with a view to the ultimate formation of an association. A further meeting will be held when the details of the scheme are ready and the replies of all the producers to a circular addressed to them have been received.

£69,000 on Unemployment Relief Work

It was reported to Cornwall County Council that 260 men were engaged on unemployment relief works and improvement schemes, including 83 on the widening between Mitchell and Penhale, and 80 on St. Austell by-pass road. As against an expenditure of £61,000 during the previous year, the expenditure on unemployment relief works was £69,000, and the bonus had been allocated to the staff according to the Committee's recommendation, and the surveyor asked for consideration to his own services in view of the additional work of these schemes. It was stated that for each of the two previous years the surveyor was paid £100, and the sub-surveyors received one-third of one per cent. on the total expenditure. Mr. E. H. Hoskin said it was only right that the surveyor should have the £100. It was decided to make grants similar to those made previously, the surveyor remarking that his additional remuneration worked out at one-sixth of one per cent., and this, and that allowed the sub-surveyors, was also very low, many districts allowing as much as one per cent.

Wake Up, Fowey!

At Fowey Town Council meeting a letter was read from Mr. F. A. Hobbs, of the firm of Hobbs, Lindsay and Co., shipbrokers, Fowey, expressing surprise that the Council had not accepted the offer of the G.W.R. to pay 50 per cent. on advertising Fowey if the Council would find 35 per cent. and the tradespeople 25 per cent. Mr. Hobbs stated that during an extensive tour of the United Kingdom he was surprised to find how little Fowey was known. At banks and post offices in large towns the clerks did not know there was such a place and had to look up the directory to find out. He himself offered to find 10 per cent. of the Council's 50 per cent. if they would take up a scheme. Mr. Hobbs concluded his letter with the words "Wake up, Fowey!"

Councillor Hambrook agreed, and Councillor Whetter, as one who was responsible for bringing up the matter previously, said 60 per cent. was now guaranteed, and surely the Council could make up the other 40 per cent. He suggested that they open a subscription list and see what would be forthcoming from the townspeople of Fowey. They need not do a great deal of advertising to start with, but he certainly thought they

should take advantage of the chance. On his motion the matter was referred back for further careful consideration.

Hauliers' Action Against Clay Co.

Before Judge Gurdon at St. Austell County Court, Mr. Walter Graham (Stephens, Graham Wright and Co.) referred to the case of Passmore and Sons, hauliers, of Okehampton, *v.* Meeth (North Devon) Clay Co., Ltd., which had been remitted from the High Court. The amount of the claim was £186 18s. 5d., in respect of which £117 2s. 6d. had been paid into court. Mr. Graham stated that Mr. W. Newcombe, for the plaintiffs, was agreeable for the reference of the matter to the Registrar. The question was whether or no these were the proper carriers to pay and whether other carriers had been paid for particular trucks that had been loaded for which the plaintiffs in this case were entitled to be paid.—The Judge suggested that it was a case for arbitration, and Mr. Graham said they had offered arbitration but it was refused. The investigation would take some time. The Judge decided that as the Registrar was too busy to go into the matter, the accounts be referred to a referee agreeable to both parties, and failing his appointment in 14 days that they be investigated by the Registrar and that the referee or the Registrar furnish his report by July 1, after which his Honour would consider the report.

Prompt Rescue at Fowey

Fowey was the scene of a stirring rescue last month. Three foreign sailors from a vessel that was being loaded with china clay had gone out for a sail and got into rough water. They hauled down the sail, took to the oars, and tried their utmost to regain the harbour, but could make no headway. Their strength began to fail, they lost an oar, and the boat was swamped.

Fortunately their struggle was seen by Miss Foy Quiller-Couch, the daughter of Sir Arthur and Lady Quiller-Couch, who knows the coast well. Miss Quiller-Couch saw that unless help reached the sailors quickly they would be cast on the rocks, and she was soon speeding across the harbour in a motor boat to the rescue. Meanwhile the plight of the sailors had been seen by others in Fowey and in Polruan, on the opposite side of the harbour, and Miss Quiller-Couch's dash to the rescue was watched with intense interest. She arrived in time, and by clever manipulation intercepted the other craft and took it in tow. With great difficulty it was brought into harbour.

Miss Quiller-Couch is an experienced yachtswoman, and in Fowey she is regarded as capable of handling a boat as well as any fisherman, and she knows the coast thoroughly. [61]

Improved Employment Position

A gratifying decrease in unemployment was reported at the last meeting at Redruth of the Mid and West Cornwall Employment Committee, Sir Arthur Carkeek presiding. The unemployment returns presented by the secretary (Mr. F. C. Bond) showed that the number of persons registered for unemployment in the area was 2,534 (2,370 men, 40 boys, 106 women and 18 girls), a decrease of 423 men, 4 boys, 109 women and 14 girls, total 550, compared with the previous month. The numbers registered at the various exchanges were (last month's totals are given in parentheses): Redruth, 452 (575); Camborne, 350 (400); Falmouth, 720 (811); Fowey, 98 (121); Hayle, 221 (327); Helston, 60 (92); Newquay, 13 (40); Penzance, 232 (268); Perranporth, 20 (33); St. Austell, 168 (186); St. Columb, 35 (37); St. Just-in-Penwith, 60 (50); Truro, 96 (144). Of the total of 2,534 persons unemployed, 459 were working short time or in casual work. Mr. Bond said that a considerable number of men had been placed in local mines during the month. There seemed to be a steady improvement in the tin mining industry. Wheal Kitty Mine, St. Agnes, had taken on additional men. At Falmouth the position was better, but work was fluctuating. Employment in the China Clay trade was very good. Mr. J. Donovan (Falmouth) said the Falmouth Docks Company had assured him that local labour would be employed on their new dry dock scheme.

Fowey Shipbroker's Rate Protest

At Tywardreath Petty Sessions Mr. Frederick A. Hobbs, a Fowey shipbroker, well known as a charterer for China Clay cargoes, was summoned in respect of the non-payment of rates amounting to £43 10s. for the half-year beginning April, 1925, and £43 10s. for the half-year beginning October, 1925, due in respect of his property at Golant-Torfrey Hotel. Mr. Richard Phillips, assistant overseer, gave evidence of the rates and the demands made. Mr. Hobbs said he had declined to pay the rates and had allowed the case to come to court so that publicity might be given to complaints calling for redress, particularly the disgraceful state of the roads from Torfrey down to Golant, and also along to the churchyard. He had complained continually to the assistant overseer and the overseers for the last two or three years, but nothing had been rectified. He also made complaints about the sanitary arrangements. While the village of Golant was swept up every week, the road outside Torfrey was swept up only twice a year and one man had to look after nine miles of road. He therefore appeared there in the public interest to protest. When the rates were 1s. 4d. in the £ for the half-year he fared far better than now when they were 7s. If someone did not take the matter up against paying rates and taxes for services he did not get they would be crushed under officialism.

The Chairman suggested that if he was not satisfied he should take action against the Council. In ordering Mr. Hobbs to pay, he said, "You have served your purpose by not paying before."

China Clay Reported in South Africa

Enormous deposits of China Clay, the quality of which is said to be equal to that now being imported from Cornwall, have been discovered in South Africa, according to American reports. A representative of the company that is exploiting the deposits has been in U.S.A. and when interviewed by *Drug and Chemical Markets* he stated that these deposits were the only source of supply of high grade China Clay in the world with the exception of Cornwall and Germany.

One vein of the South African deposits is estimated at 7,000,000 tons, another one estimated at 2,000,000 tons, and there are many others that have not been estimated. It is claimed that the supply is practically unlimited. The deposits are located right in the municipality of Cape Town, South Africa, and are at a depth of only two feet below the surface. The clay is taken from the earth in a condition that requires practically no washing to make it suitable for marketing, although for some purposes further treatment is necessary. The recovery of the clay is not as difficult as it is in Cornwall. The railroad is only 300 yards from the deposits, and a six-mile haul is all that is necessary to the seaboard.

While the freight rate is something of a handicap, it is claimed that this can easily be overcome in view of the lower production costs. The annual production in Cornwall, says the paper, is estimated at 885,500 tons, which requires a pit with perpendicular sides 150 ft. deep, covering 11 acres. Since a pit of 150 ft. depth cannot have perpendicular sides, the area required is approximately 22 acres.

Cornwall's Five Rating Areas

At a recent meeting of the St. Austell Rural Council there was some discussion over a letter from the Liskeard Rural District Council asking the support of the Council to a resolution that the number of rating valuation areas should be eight or nine instead of five, as decided upon by the County Rate Basis Committee. The question of the new rating areas being set up is of considerable financial interest to China Clay firms. Mr. J. R. James, in opposing, favoured the smaller number, or less than that, otherwise he thought they would have the same anomalies as they had under the present arrangement. In some cases there were very valuable properties, rated at about half their value, and in others up to the hilt, which meant that the latter bore an unfair proportion of the county rates.

Mr. F. W. Jenkin, who was one of the Council's representatives at Truro, said that the reason the County Rate Basis Committee favoured five areas was because the county was divided into five areas for certain other purposes, and they were told that if they asked the Ministry for the same number as at present they would not get it, but if the delegates had decided on eight he believed the County Rate Basis Committee would have adopted that number. As regards any inconvenience to appellants, he had heard that appeals would be heard in different parts of various areas, which would make it easy for people to attend. If they did not have fewer areas than at present they would only be retaining the anomalies that at present existed.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—April, 1926

Arrivals

Date.	Vessel.	From
April 3	*Judia*	Falmouth
April 4	*Leelite*	Plymouth
April 4	*La Revanche*	Newlyn
April 7	*Shoal Fisher*	Looe
April 8	*Dunmore*	Teignmouth
April 8	*Seaforth*	Fowey
April 9	*Duchess*	Runcorn
April 10	*Concorde*	Looe
April 13	*R. Passmore*	Goole
April 13	*Henrietta*	Newlyn
April 28	*Gou Gou*	Cardiff
April 28	*Libelle*	Torquay
April 28	*Seaforth*	Fowey
April 28	*Goole*	Truro
April 29	*Miriam Thomas*	Dover
April 29	*Wans Fell*	Methil
April 29	*Jantje Grunefeed*	Truro

Sailings

Date.	Vessel.	Destination
April 1	*Guardian*	Sunderland
April 1	*Ortona*	Riddum Dock
April 9	*La Revanche*	Nantes
April 10	*Leelite*	Tayport
April 10	*Dunmore*	Runcorn
April 13	*Seaforth*	Glasgow
April 13	*Julia*	—
April 14	*Concorde*	Leith
April 15	*Shoal Fisher*	Chester
April 23	*Henrietta*	London (Dartford)
April 23	*R. Passmore*	Terneuzen (via Par)
April 26	*Duchess*	Runcorn
April 29	*Seaforth*	Antwerp
April 29	*Goole*	London
April 30	*Libelle*	London

Fowey Shipping—April, 1926

Arrived.	Name.	Sailed.	Destination.
April 1, S.S.	*Grit*	April 7,	Northfleet
April 1, M.V.	*Shamrock*	April 3,	Plymouth
April 1, M.V.	*Mayblossom*	April 2,	Pentewan
April 1,	*W. E. Gladstone*	April 5,	Pentewan
April 3, M.V.	*Gretze*	April 7,	Odense
April 3, S.S.	*Glynconwy*	April 7,	Birkenhead
April 3,	*Amy*	April 5,	Plymouth
April 3, S.S.	*Ilse*	April 7,	Harburg
April 4, S.S.	*Eltham*	April 8,	Calais
April 4, S.S.	*Hayle*	April 8,	Hull
April 4, S.S.	*Moss Rose*	April 7,	Fleetwood
April 4, S.S.	*Brier Rose*	April 8,	Preston
April 4, S.S.	*Calluna*	April 13,	Brussels
April 5, S.S.	*Thyra*	April 14,	Boston
April 5, S.S.	*Claretta*	April 7,	Leith
April 7,	*Merite*	April 9,	Par
April 7, S.S.	*Haig Rose*	April 13,	Rouen
April 7,	*Else*	April 24,	Gefle
April 7, S.S.	*Southwell*	April 12,	Pasages
April 8, S.S.	*Joffre Rose*	April 14,	Weston Point
April 8, S.S.	*Wans Fell*	April 13,	Grimsby
April 8, S.S.	*Sunniside*	April 15,	Pasages
April 9, S.S.	*Annaho*	April 16,	Sarpsborg
April 10, M.V.	*Shamrock*	April 13,	Plymouth
April 11,	*Mary Barrow*	April 30,	Rochester
April 11, S.S.	*Jarrix*	April 16,	Antwerp
April 11, S.S.	*Horn*	April 17,	Bo'ness
April 11, S.S.	*San Francisco Maru*	April 23,	Portland, Me.
April 11,	*Falken*	April 24,	Reval
April 11,	*R. Passmore*	April 14,	Charlestown
April 12, M.V.	*Hope*	April 13,	Pentewan
April 12, S.S.	*Gouwestroom*	April 22,	Amsterdam
April 12, S.S.	*Primrose*	April 17,	Preston
April 12, S.S.	*Overton*	April 16,	Birkenhead
April 14, S.S.	*Falmouth Castle*	April 20,	Runcorn
April 15, S.S.	*Katherine*	April 20,	Salcombe
April 15, S.S.	*Elvier*	April 22,	Antwerp
April 15, S.S.	*Yorkdale*	April 21,	Amsterdam
April 15, S.S.	*Guelder Rose*	April 21,	Fleetwood
April 16, S.S.	*Ferndene*	April 22,	Rouen
April 16, S.S.	*Ortona*	April 22,	Ridham
April 17, M.V.	*Lydia Cardell*	April 23,	Rouen
April 18, S.S.	*Desia*	April 24,	Drammen
April 18, M.V.	*Drogden*	April 23,	Munkedal
April 18, S.S.	*Alice*	April 23,	Preston
April 18, S.S.	*Dragoon*	April 21,	Liverpool
April 18, S.S.	*Tanny*	April 22,	Bristol
April 18, M.V.	*Hope*	April 19,	Plymouth
April 18, S.S.	*Stonwell*	April 24,	Ridham
April 19,	*Wellington*	*	Pentewan
April 19, S.S.	*Lancaster Castle*	April 29,	Portland, Me.
April 19, S.S.	*Sittang*	May 7,	Philadelphia
April 19, S.S.	*Bangor*	April 24,	Gravesend
April 20, S.S.	*Moss Rose*	April 24,	Weston Point
April 20, S.S.	*Wearside*	April 26,	Aviles
April 22, S.S.	*Pansy*	April 26,	Ridham
April 22, S.S.	*Waterway*	April 28,	Antwerp
April 22, S.S.	*Clydeburn*	April 24,	Boulogne
April 22, S.S.	*Farfield*	April 29,	Grimsby
April 22, S.S.	*Jellico Rose*	April 29,	Antwerp
April 22, M.V.	*Dietrich Hasseldiech*	April 29,	Harburg
April 23, M.V.	*Zeehound*	April 27,	Abö and Hangö
April 23, S.S.	*Brier Rose*	April 29,	Runcorn
April 24, S.S.	*Seaforth*	April 28,	Charlestown
April 24, S.S.	*Dorset Coast*	April 28,	Liverpool
April 25, S.S.	*Alice*	April 27,	Par
April 25, S.S.	*Agate*	April 28,	Swansea
April 25, M.V.	*Mayblossom*	April 26,	Plymouth
April 26, S.S.	*Ravenspoint*	April 29,	Genoa
April 26,	*W. E. Gladstone*	April 27,	Pentewan
April 26, S.S.	*Fernhill*	*	Newfoundland
April 27, M.V.	*Shamrock*	April 28,	Plymouth
April 27, S.S.	*Clara Monks*	April 30,	Weston Point
April 27, S.S.	*Falmouth Castle*	May 1,	Runcorn
April 27, S.S.	*Ambleside*	May 3,	Brussels
April 27, S.S.	*Katherine*	April 28,	Plymouth
April 29, S.S.	*Jacob Maersk*	*	New York
April 29, S.S.	*Horn*	May 5,	Pasages
April 29, S.S.	*Primrose*	May 4,	Preston
April 29, S.S.	*Pylades*	May 1,	Methil
April 29, M.V.	*Laanemaa*	May 6,	Helsingfors
April 30,	*River Fisher*	May 4,	Barrow

* Signifies " In Port."

Par Harbour Shipping—April, 1926

Sailings

Date.	Vessel.	Destination.
April 1, M.V.	*Cornelia*	Terneuzen
April 1, S.S.	*Birmingham*	Manchester
April 3, M.V.	*Anniemarie*	Antwerp
April 3, M.V.	*Ilse*	Dundee
April 3, S.S.	*Treleigh*	Preston
April 6, S.V.	*J.N.R.*	Pentewan
April 12, S.V.	*Hilda*	Antwerp
April 13, S.V.	*Guiding Star*	Queenborough
April 13, S.V.	*Carmenta*	Rochester
April 14, S.S.	*Castlerock*	Barry
April 16, S.V.	*Margrietha*	Antwerp
April 16, S.S.	*Magrix*	Antwerp
April 17, S.V.	*Snowflake*	Runcorn
April 19, S.S.	*Trader*	London
April 23, S.V.	*Merite*	Runcorn
April 23, M.V.	*Kehdingen*	Antwerp
April 23, M.V.	*Grit*	Queenborough
April 23, S.V.	*Winifred*	Pentewan
April 26, S.V.	*Emily Warbrick*	Weston Point
April 26, S.V.	*Englishman*	Weston Point
April 27, S.V.	*R. Passmore*	Terneuzen
April 28, S.V.	*Lady Roseberry*	Rochester
April 28, M.V.	*Hope*	Pentewan
April 29, M.V.	*Regina*	Pentewan
April 29, M.V.	*Diligent*	Mevagissey

Arrivals

Date.	Vessel.	From
April 2, S.S.	*Treleigh*	Portreath
April 4, S.V.	*Carmenta*	Newlyn
April 9, S.V.	*Merite*	Porthoustock
April 9, S.V.	*Snowflake*	Mevagissey
April 10, S.V.	*Margrietha*	Teignmouth
April 12, S.S.	*Castlerock*	Goole
April 13, S.S.	*Magrix*	Teignmouth
April 15, M.V.	*Kehdingen*	Scilly Isles
April 16, S.S.	*Treder*	Kingsbridge

April 17,	S.V. *Two Sisters*	Porthoustock
April 18,	S.V. *Penryn*	Penryn
April 18,	S.V. *Emily Embrick*	Falmouth
April 19,	M.V. *Grit*	London
April 20,	S.V. *Englishman*	Truro
April 22,	S.V. *Lady Roseberry*	Torquay
April 22,	S.V. *Winifred*	Plymouth
April 23,	S.V. *R. Passmore*	Charlestown
April 25,	S.V. *Pedestrian*	London
April 26,	M.V. *Hope*	Porthoustock
April 27,	S.V. *Pearl*	Porthoustock
April 27,	S.S. *Alice*	Fowey
April 27,	M.V. *Regina*	Plymouth
April 28,	M.V. *Diligent*	Plymouth
April 28,	S.V. *S. F. Pearce*	Plymouth
April 30,	S.S. *Guardian*	Portleven
April 30,	M.V. *Jupiter*	Truro

Par Harbour Tide Table, June, 1926

(British Summer Time Throughout.)

Day of Week.	Day of Month	Morning.	Afternoon.	Height.
Tuesday	1	9.35	10.1	11.10
Wednesday	2	10.28	10.57	11.3
Thursday	3	11.28	—	10.9
Friday	4	0.1	0.37	10.7
Saturday	5	1.17	1.58	10.11
Sunday	6	2.37	3.13	11.6
Monday	7	3.46	4.16	12.1
Tuesday	8	4.44	5.9	12.5
Wednesday	9	5.33	5.55	12.8
Thursday	10	6.16	6.37	12.10
Friday	11	6.57	7.16	12.8
Saturday	12	7.34	7.51	12.5
Sunday	13	8.8	8.25	12.0
Monday	14	8.43	9.1	11.7
Tuesday	15	9.20	9.38	11.1
Wednesday	16	9.57	10.17	10.6
Thursday	17	10.38	11.1	10.1
Friday	18	11.26	11.53	9.9
Saturday	19	—	0.22	9.8
Sunday	20	0.54	1.28	9.11
Monday	21	2.3	2.38	10.5
Tuesday	22	3.11	3.42	11.0
Wednesday	23	4.10	4.35	11.8
Thursday	24	4.59	5.22	12.3
Friday	25	5.44	6.6	12.8
Saturday	26	6.28	6.50	12.10
Sunday	27	7.13	7.36	13.1
Monday	28	7.58	8.21	13.1
Tuesday	29	8.44	9.8	12.10
Wednesday	30	9.33	9.57	12.5

E. CLEMENS, Harbour Master.

China Clay Exports for April, 1926

A RETURN showing the exports of China Clay, including Cornish or China stone, the produce or manufacture of the United Kingdom from the United Kingdom to the countries of destination registered during the month ended April 30, 1926.

COUNTRY OF DESTINATION.	CHINA CLAY. QUANTITY. Tons.	VALUE. £
Sweden	1,132	1,678
Norway	642	1,350
Denmark	576	1,525
Germany	1,447	3,338
Netherlands	2,701	5,133
Java	105	395
Belgium	4,626	8,031
France	2,540	3,757
Spain	1,457	3,985
Italy	3,188	7,816
China	10	54
United States of America	24,277	48,831
Mexico	62	250
Brazil	21	103
Cape of Good Hope	—	6
Natal	1	9
Bombay via other Ports	1,306	5,612
Madras	8	32
Bengal	762	2,229
Australia	39	201
New Zealand	10	37
Canada	39	68
Falkland Islands	2	4
Irish Free State	1	5
Total	44,952	94,449

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

County Court Judgment

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.]

CENTRAL CORNWALL CHINA CLAY CO., LTD., St. Blazey, manufacturers. £28 13s. 5d. January 28.

Mortgages and Charges

*[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]*

COLOROLL, LTD., London, N.W., paper manufacturers.—Registered March 26, £500 and further advances debenture, to F. T. Cook, 5, Station Road, Harlesden, builder; general charge (subject to prior debenture). *£500. July 21, 1925.

DURHAM PAPER MILLS, LTD., London, W.C.—Registered April 27, £25,000 (not ex.) charge, to Bank; charged on Durham Paper Pulp Works, West Hartlepool.

NEWTON ABBOT CLAYS, LTD.—Registered April 20, debenture to Bank; charged on properties at Dorbears, Kings Meadow, Knighton Heath and Newton Abbot, also general charge. *Nil. July 28, 1925.

THYNNE (H. & S.), LTD. (late GODWIN AND THYNNE, LTD.), Hereford, tile manufacturers.—Registered April 7, agreement postponing date of redemption of £11,800 debentures; general charge. *£17,800. February 11, 1926.

VERNON (A. E.) AND CO., LTD., Burslem, earthenware manufacturers.—Registered April 1, £1,000 mortgage, to Mrs. M. H. Hodgkinson, Highbury, Congleton, charged on The Hill Pottery, High Street, Burslem. *Nil. September 1, 1924.

WATERSIDE PAPER MILL CO., LTD., Darwen.—Registered April 19, £1,000 mortgage, to J. Almond, 161, Roman Road, Blackamoor; charged on Bent Farm, Eccleshill, Darwen. *£1,000. May 20, 1925.

Satisfactions

EMPIRE PAPER MILLS (1922), LTD., London, E.C.—Satisfaction registered April 28, £650,000, registered October 26, 1922.

FLETCHER (ROBERT) AND SON, LTD., Stoneclough, paper manufacturers.—Satisfaction registered April 21, £8,000, registered March 8, 1921.

THYNNE (H. AND S.), LTD. (late GODWIN AND THYNNE, LTD.), Holmer, tile manufacturers.—Satisfaction registered April 8, £6,000, registered February 8, 1921.

Duty on Wrapping Papers

A PROVISION of this year's Budget presented on April 26 by Mr. Winston Churchill is the imposition of a duty on imports of packing and wrapping paper as from May 1, 1926, at the rate of 16⅔ per cent. *ad valorem*, with a preferential rebate of one-third in favour of Empire goods. This duty is estimated to yield £400,000 in the first year and £550,000 in a full year.

China Clay Imports for April, 1926

A RETURN of the registered imports of China Clay, including china stone, into Great Britain and Northern Ireland during the month of April, 1926, shows one consignment from Germany of two tons valued at £21.

The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests. Published in the third issue of "The Chemical Age" each month.

All Editorial communications should be addressed to the Editor, "The China Clay Trade Review," Benn Brothers, Ltd., Bouverie House, 154, Fleet Street, E.C.4. All communications relating to Advertisements, Subscriptions, etc., should be sent to the Manager, "The China Clay Trade Review," at this address. Telegrams—"Allangas, Fleet, London." Telephone—City 0244 (10 lines).

China Clay Producers Association

WE learn by wire from St. Austell that at a meeting of the China Clay producers, on Tuesday, it was decided to ask the Best Clays Association for an extension of time to complete arrangements for an all-in association. This decision seems to be a very hopeful one. The notes published below were written before the result of the meeting was known, but they form a fair analysis of the position.

All-in Association Proposals

The circumstances calling for the establishment of such an association, its justification, advantages, and other factors incidental to the project, are worthy of analysis and review in order that all concerned may see the position in its proper perspective.

In the first place it must be admitted that it is not an easy task for any body of men to undertake the reconciling of conflicting interests and to produce a formula that will appeal to everybody's sense of equity and business at one and the same time. That is where a disposition to give and take is essential if a successful organisation having for its object the safeguarding of the interests of all concerned in the industry is to be built up and have in it the germs of permanency.

Sequel to the 1924 Disaster

Since September, 1924, when the old association was disbanded, the industry, except that part of it dealing with the best China Clays, has suffered enormously from what was predicted at the time and which has since been proved to be a disaster to its well-being and prosperity. That is due to the fact that there has been no systematic grading of medium and common clays, no guarantee that a clay at a certain price is equal in quality to another clay at the same price, with the result that sellers have had to submit to the auctioneering methods of buyers who have depressed the price by the use of the old bartering argument that they could get elsewhere supplies at the price offered by them. Under such a process of doing business as this, producers have been at the mercy of buyers, who have secured their supplies of the commodity at prices that have not borne a true relation to its value, having regard to the labour and capital employed in its production. Such a result is inevitable where there is over-production unless means are adopted, collectively, of counteracting it.

Wise Best Clay Producers

That is what has happened in the case of the cheaper grades of clay, but the producers of the best clays have been wiser. After the break-up of the old "all-in" association, the producers of best clays continued the organisation under the name of China Clay Producers, Ltd. They have reaped the benefit of their wisdom and foresight by selling their clays at in most cases highly remunerative prices. And, as an indication that this policy has not been detrimental to their interests as regards volume of trade done, they last year did nearly two-thirds of the total tonnage of the whole industry. This proves conclusively that an association, conceived in the right spirit and carried out on strict lines of equity and justice to all the individuals forming it, is a source of strength.

Existing Association's Co-operation

A feature of the movement for the formation of an "all-in" association has been the readiness with which the Best China Clays Association have been willing to consider the linking up of their organisation with what, for the want of a more expressive term, are described as the "outsiders." It has not been a case of the Best Clays Association and those outside throwing all their interests into the melting pot together and evolving an entirely new organisation therefrom, but using the existing association as a nucleus for building up the larger association proposed. This has, of course, involved the ascertainment from the Best Clays Association by the Executive Committee of the proposed "all-in" grouping of the basis on which they would entertain the outsiders joining them. That basis the Executive Committee, after investigating the facts that were produced to them in support of it, felt was one they could recommend the "outsiders" to accept in the aggregate. This the "outsiders" did accept subject to the working out of details.

Time Limit

There are many factors that make it necessary that such a project as has been in contemplation should be brought to finality one way or the other, and should not be allowed to drag on indefinitely. In any case the scheme could not come into operation until the beginning of next year, but there is the question of contracts for next year, the consideration of which has been in suspension until the question of the association was decided. The Best Clays Association therefore requested the outsiders' executive to let them have their decision one way or the other this week. Hence meetings have been held this week, the result of which is published above.

Coal Strike Effects

The coal strike is having its effect upon the China Clay industry in the restriction of the consumption of coal for drying purposes. In many cases the drying of clay at some works has been suspended in order that sufficient coal stock may be kept in reserve to keep the engines driving the pumps and incline wagons. This has meant a lessening of employment which has taken the form of a lessening of hours rather than the discharge of men. English China Clays, Ltd., the largest firm engaged in the industry, has reduced their working hours from 7 to 6 per day. Messrs. Lovering and Co. have transferred men normally engaged in the dries to other duties in the works where the drying of clay has had to be suspended.

The restrictive measures that have had to be adopted have lessened the production of certain grades of clay for which there is a fairly brisk demand. As a result of the difficulty to keep up supplies and the increased cost of production of such supplies as are available, the prices of clays have hardened and are likely to be generally higher. In this upward tendency the cheapest grades of clay are participating, as firms are concentrating on the drying of best in preference to lower grades.

Modern Plant in China Clay Works

Its Effects on Finished Products

THE introduction of modern machinery into China Clay works is a comparatively recent development. China Clay, as every consumer of China Clay knows, is washed from the sides of a pit, the clay stream pumped to the surface, and the impurities it contains removed by distributing the stream over a series of troughs or drags to reduce its speed so that the foreign matter in suspension can settle.

Prior to 1913 the method adopted for "winning" China Clay was to allow a stream of water to flow over the side of the pit and the clay face. Men were employed breaking the clay from each side into this rapidly falling stream or "strake" which soaked the lumps of clay, and carried away with it clay, mica, sand, etc., the sand and coarse mica being trapped in sand boxes. The workmen would also "puddle" the clay—*i.e.*, break the lumps of clay in the stream to disintegrate them as much as possible so that the water might take with it in suspension a fair proportion of China Clay particles. It is a method which undoubtedly lends itself to the production of a fine grained clay of distinct type and texture.

A recent method is to employ pressure hoses, the pressure obtainable depending on the head—*i.e.*, the surface water comes down a column and issues from the nozzle under the influence of gravity with considerable force. Water under pressure is more effective in disintegrating the lumps of clay than a running steam of water. This method is more efficient from the point of view of quantity, and a hose can be directed on to any part of the face at will. The clay produced by this method is the same as the clay produced by "streaming" as far as its texture and fineness is concerned, if the purifying methods are the same. Thus, until very recently, after the water had washed its quota of clay from the face, the clay stream was allowed to flow gently from point to point depositing its sand and other coarse particles until it came to the shaft and was pumped to the surface for final purification.

Centrifugal Pumps

At the present time, powerful centrifugal pumps are installed in many of the China Clay mines which were originally laid out for producing by the older and gentler methods. The actual washing of the China Clay from the face by streaming or by pressure hoses remains the same, but the essential difference between the old and the new method is that *before* the clay stream is allowed to deposit its sand and other coarse material, it is passed through a gravel pump. Water, clay, sand, and anything solid up to the size of a tea cup which the water carries with it or rolls before it, are drawn through the suction pipe, churned round and round by steel impellers and forced up through a delivery pipe with considerable speed. The sand is conveniently removed *after* the stream has been well churned in the pump, and this churning, while it thoroughly disintegrates the coarse clay into fine particles, also disintegrates some of the other materials that accompany China Clay or kaolinite in the stream. The presence of these minerals may enhance or reduce the value of the clay from a pottery point of view. Their separation from the clay is rendered extremely difficult, if not impossible, owing to their physical condition. They are so small that they remain in suspension in the water and pass along with the clay into the settling pits, the gravel pumps having a grinding effect.

Old and New Methods

By the older method of sedimentation most of the heavier and coarser minerals that accompanied China Clay in the stream, as it came from the face, were either deposited in the sand pits or at some other point before or after the stream reached the surface. By the new centrifugal pumping method a proportion of this extraneous matter, good or bad, is reduced in grain and mixes with the clay. This may account for the difference in behaviour of two samples of the same clay from the same pit, one produced before and the other after the introduction of a centrifugal pump. Those pottery clays obtained from pits which since their inception have used centrifugal pumps will, of course, find their own markets. It is not suggested that the China Clays are any the worse for having been through the pump with sand, etc., but there is a difference in the clays, altogether apart from any variation due to other causes, such as a difference in the state of the granite and the extent of the refining.

To summarise the matter briefly, by the old method only the softest portion of the decomposed rock actually passed into the refining troughs; by the second method (hydraulising) a proportion of coarse clay hitherto left in the sand pits becomes broken down and mixes with the clay stream; by the third method soft clay, hard clay, semi-decomposed felspar, soft mica, and sand are all subjected to a grinding process that may alter the ultimate proportions of the constituents of the clay when ready for the market. CHINA CLAY ENGINEER.

Oil Fuel for China Clay

A Review of Possibilities

ONE fact stands out very clearly in the China Clay industry to-day, and that is that those works which do not rely on coal, but can use oil fuel for generating electricity, for pumping and hauling, and for heating, are able to continue production in much the same way as usual, while those which are dependent on coal as their basic fuel are either closed down or producing under difficulties. Since the last coal strike a large number of experiments have been carried out by China Clay producers with a view to circumventing the perennially recurring uncertainty of coal supplies. Oil has been tried in many directions, and it has been definitely proved that coal can be dispensed with if absolutely necessary.

Uses of Oil Engines

Oil engines have become fairly common. Oil engine units vary from small oil engines directly coupled to pumps lifting 80 gallons per minute against 100 ft. head, to higher powered units capable of generating electricity sufficient to do all the necessary haulage work, pumping, etc., of a well organised clay works with a large output. The pumping sets function in different ways. Some are to work pressure pumps in shallow pits where the natural head of water may not be such as to give enough pressure at the hose nozzle to wash the clay, and where it is difficult to wash it without a pressure hose. China Clay washing from mine to settling pit is usually so arranged that the supernatant water in the settling pits flows back to the clay mine to wash more clay, but there is an unavoidable loss of water during the washing and settling processes, and the necessity often arises of supplementing or augmenting the usual supplies by drawing water from a distant spring or stream. Pumps are required for pumping such water to the mine, and oil engines are used to drive the pumps.

Electricity from Oil

Occasionally oil engines directly coupled to sand pumps are used to open new mines or deepen old ones, the clay being pumped direct to the surface or to the level required. The old method of opening a clay mine was to sink a shaft to a suitable depth, 100 to 200 ft., drive a level and bring up a rise through the clay bed. The clay was washed down the rise, it flowed along the level, and was then pumped to the surface *via* the shaft, an obviously roundabout and expensive method of development and production. At the present time single and multiple centrifugal pumps capable of lifting a stream to any practicable working height can be installed at a reasonable cost. The best drive for centrifugal pumps is an electric one, and electricity can be generated on the spot from dynamos driven by crude oil engines. As a matter of fact, crude oil is used quite extensively in the industry for large internal combustion engines of 100 to 200 B.H.P. driving dynamos by belt drive, or directly coupled to dynamos supplying current for pressure hoses, sand and gravel pumps, and haulage plant. In many works electric motors, geared down, are occasionally used to work the ordinary Cornish ram pumps. Fuel oil has also been tried in the kilns for drying clay. Any coal-fired kiln may be adapted to burn oil as fuel, and one or two kilns have been specially constructed for the purpose of burning oil. To dry clay by means of coal is probably cheaper, but oil firing of kilns has its advantages.

The Cornish clay producers are naturally conservative and do not readily make changes. Once they begin to change, however, they progress steadily along the lines they lay down for themselves. Since the last coal strike great strides have been made in the application of oil in the industry. The present strike has proved that producers having plant driven by oil are more capable of continuing and retaining their business than those who are compelled to stop or lessen production for want of coal. E. J. L.

Sands for Special Purposes

Possibilities of China Clay Sand

In view of the uses to which China Clay sand is now put, the following information on the use and preparation of sands for various industrial purposes should prove interesting to our readers. The general term "sand" applies to a multitude of similar materials consisting of fine granular mineral. As usually understood it means the ordinary natural product used for structural purposes and made up largely of grains of quartz. Quartz sand constitutes by far the greater bulk of the production, but there are other grades used for industrial purposes, such as moulding sand, glass sand, and many others that may be grouped under the general name of special sands.

Nearly all special sands must be clean and free from excessive fines and clay coating. This means that they must be washed, and a suitable supply of water for this purpose is required. In some plants the entire output consists of one or more grades of special sand, and the treatment then resolves itself into washing, followed in some cases by drying and screen sizing. Hydraulic classification is not used for the separation of closely sized sands. At many plants the special sand produced is only a by-product. For example, some plants that ship glass sand as their main product also make sand-blast, filter and abrasive sand, and sand for pulverising. Some plants that produce steel-moulding sand or commercial gravel-and-sand, also produce several grades of sand-blast and filter sand. The size of the natural sand-grains and the mineralogical composition of course place limits upon the special sands that can be prepared.

Washing.—Unconsolidated sands are washed in the ordinary way by means of scrubbers, screens and settling tanks. In the main production must be unusually clean, as for glass sand, more thorough washing is given. Two methods, or slight modifications of them, may be used to treat the wet washed sand: First, either the total amount passing through the plant is separated into the respective sizes, or a fraction of the total amount is split off and so separated; or, second, a part of the sand between a certain minimum and maximum is cut out and prepared as special sands. The first method is followed when all the material from coarse to fine may be used in some grade of special sand for which there is a market. It is the simplest and most common method. The second method is applied when a market exists only for grades between certain limiting sizes, and when the removal of some of these grades from the entire unsorted product will not damage, or may even improve, the grade of the remainder.

Drying.—Most special sands are shipped dry. For this reason it is simpler to dry the entire production at one operation and separate the dry sand, rather than to separate by wet screening and separately dry each size. Dry screening is more perfect than wet, especially for the finer grades, because of the surface tension of the water, which may cause a small amount of fines to adhere to the coarser grains and be carried over with the oversize. Where glass sand is prepared, steam heated dryers are almost universally used. They are all of the type in which tiers of steam pipes form the bottom of the dryer and support the wet sand. As fast as the sand dries, it falls between the pipes on to a conveyor that carries it to storage or the screening plant. This type of dryer has the advantage of low maintenance and labour cost, it is foolproof, there is no danger of discolouring or overheating the sand, and it adds no fire risk to the plant. When discoloration is not objectionable rotary direct-heat dryers burning coal, coke, or fuel oil are used. Their thermal efficiency is probably higher than that of the steam dryers, but they are a fire hazard, as overheated sand may set fire to elevator houses and bins. Coal-fired tower-type dryers are used in some plants.

Screening.—Screening practice varies somewhat with the rigidity of specifications. If a graded product from coarse to fine may be used, as for some engine sand and stone-sawing sands, one pass through a revolving screen either wet or dry, after the silt has been removed by washing, is usually enough to remove oversize and foreign matter. For close sizing between narrow limits, all types of screens, sloping, stationary, revolving and vibrating, are used. Present practice, however, tends strongly to the vibrating type, and practically all new plants are being equipped with them, even for the coarser sizes, 10-mesh to 14 in., whereas formerly they were only used for finer sizes, say below 10-mesh. If close sizing is necessary, the screens cannot be crowded to capacity. One company goes so far as to re-screen all its filter and sand-blast grades.

The principal special sands and their characteristics or main specifications are as follow:—

Filter Sand.—Filter sand is used especially for filtering municipal water supplies by mechanical or gravity filters. The sand must be clean and free from clay, organic matter, and flat particles. Not more than 2 per cent. should be soluble in hot dilute hydrochloric acid. The terms "effective size" and "uniformity coefficient" are characteristic of filter sand specifications. The effective size, expressed in millimeters, is such that 10 per cent. by weight of the sand is finer, and 90 per cent. is coarser than the given size. The uniformity coefficient is the ratio of the size of grain, than which 60 per cent. of the sand is finer, to the effective size. Although rather an awkward way of expressing size and uniformity, it is almost universally used in filter-sand specifications. Effective sizes used vary from 0·20 to 0·70 mm. and uniformity coefficients from 1·25 to 1·80.

Engine Sand.—Engine sand is used to prevent slipping of the driving wheels of locomotives of all kinds. It is a very important product, and the total production is considerable. Unsuitable and poorly prepared sand is often used, but the better managed railroads are careful to select suitable materials. It should be fairly uniform in size, free from large lumps or foreign matter that would choke the feed pipes, and free from clay, dust, or other impurities that would tend to hold or absorb moisture and develop a natural bond. Engine sand is often shipped wet and dried at the supply or storage station. An ideal sand would all pass a number 20 and be retained on a No. 80 sieve. One large railroad requires the sand to be 95 per cent. silica.

Abrasive Sands.—Abrasive sands include a large number of sands for special purposes. Some of them may require the most careful sizing and preparation, as sand-blast sands, whereas others may be ordinary unsized material such as is used for stone sawing. Usually, however, a graded or sized product is more efficient and is worth the extra cost if it does not have to be shipped too far. Sand-blast is one of the most important of the group. It is prepared in different sizes from No. 1 to No. 4 to suit different classes of work. Some producers use trade names or some method of designating the different sizes, but they approximate roughly to the above grading.

Sand for grinding stone, marble, and plate glass, and for similar purposes is usually not a graded product. However, a washed sand with excess of fines removed and large particles screened out is desirable. Some firms use the same sand for plate glass grinding as for the melt. All of one such sand passed a 28-mesh sieve, and 90 per cent. was retained on 150-mesh, being uniformly graded between these sizes. About three tons of sand are required to grind one ton of plate glass. Banding sand, a grade used for bevelling glass, is finer than most grades, and is often prepared by screening out the excess fines in glass sand or fine sand-blast sand. Usually it will have about 3 per cent. retained on a 35-mesh and 92 to 95 per cent. retained on 100-mesh screen. Sand for sawing and grinding stone is generally coarser than that used for glass. Some companies prefer to use a graded product about equal to No. 1 sand-blast sand, but most of it is not sized. One large marble company uses a washed river sand with about 4 per cent. retained on a 10-mesh and 99 per cent. retained on a 100-mesh sieve.

Formerly sand was used for coating sand-paper. Very little is now used for that purpose as it has been displaced by crushed quartz, the more efficient artificial abrasives, or garnet. Abrasive sands, in general, should be high in silica, which means a high quartz content clean and free from clay, and the grains should be tough and durable. There is some question as to the relative merits of rounded and sharp grains. Both act satisfactorily, and probably availability and price are more important than grain shape. Sharp grains are

probably faster cutting at first, but rounded grains are more durable and do not break down so quickly. The colour of abrasive sands is of no importance except as an indication of purity. There is, however, always a trade prejudice in favour of white sands.

Potters' Sand.—Potters' sand, which is also known as placing sand, is used by potters to place between the ware in the saggers, and for heavy ware between the ware in the kiln. Two grades, fine and coarse, are generally used. Both should be free from dust and fines, and fairly well sized. Material from 10 to 40-mesh is called coarse, and 28 to 100-mesh fine. Sand for white ware and refractories must be low in iron and fluxes. High purity is not essential for heavy dark ware.

Roofing Sand.—Roofing sand, as the term is here used, is employed as a coating on prepared rolled roofing. A sand white, or nearly so, is demanded and preferably a rounded-grain product. Manufacturers' requirements as to sizes vary somewhat, but generally a sand is required that will all pass 20-mesh with not more than 5 to 10 per cent. passing 100-mesh, which are about the physical requirements of a good-class sand.

Flooring Sand.—Flooring sand is the material used in asphalt mastic flooring, which consists of asphalt cement, a sand aggregate, and a fine mineral filler. The sand must be clean and free from clay and silt. It should all pass a No. 3 sieve, at least 40 per cent. should be retained on a No. 8 sieve, and not more than 8 per cent. should pass a 100 sieve.

Standard Sand.—Standard sand is a very uniformly sized product used in cement testing, or as a standard with which to compare the effect of other sands in concrete mixtures. Only the rounded-grain St. Peter sand is used, as produced at Ottowa, Ill., and after it has been carefully screened on a No. 20 and retained on a No. 30 standard sieve. The consumption is, of course, very small, as it is for laboratory use only.

Sand for Oxychloride Cement or Plaster.—Sand for oxychloride cement or plaster is an important ingredient of this material. A white sand is preferable, and it should be clean and free from clay and clay-coated grains. It must be decidedly finer than that used in Portland cement. Results have shown that a good sand for this use will all pass a 10-mesh sieve, 95 to 98 per cent. will pass a 20-mesh, and it should be well graded so that not more than 3 per cent. will pass 100-mesh. Both sharp and rounded grain sand is used.

Sand for Chemical and Metallurgical Use.—Sand for chemical and metallurgical use is needed in the manufacture of sodium silicate and the artificial abrasive carborundum, or silicon carbide. For both these uses a sand that meets the requirements of a high-grade glass sand is acceptable. For sodium silicate, however, the iron and aluminium must be especially low, as iron affects the colour and alumina the solubility of the resulting glass. For silicon carbide not more than traces of lime, phosphorous, and magnesia must be present, as they form unstable compounds. The sand should be free from dust, and in other physical properties it should be equal to a good glass sand.

Sand for Pulverising.—Sand for pulverising is used as a source of ground silica or quartz for paint filler, fine-grained abrasives, pottery, stucco, wall board and special plasters, foundry parting, soaps, and similar uses. Only high-grade silica sands are suitable, as both chemical purity and colour are important. The regular run of prepared silica and glass sands are used, and sometimes the fines screened out in the preparation of coarser closely-sized products, such as filter and sand-blast sands. Dust and fines are not objectionable unless they contain undesirable impurities. Iron oxide is objectionable and should be less than 0·05 per cent. Small amounts of alumina, lime, and magnesia are not harmful. Oxides of other metals (such as titania) are also objectionable.

Possible By-products.—In the preparation of so cheap a commodity as sand, a possible recovery of valuable by-products would hardly seem probable. Although this is true for most plants, it is believed that there are exceptions worthy of investigation. At some plants preparing a high-silica sand for various purposes wash water is settled and the fines marketed for special grades of moulding sand, surfacing for tennis courts, and sand for other uses. Also, it is believed, possible uses exist for the oversize screened out of some special sands, now thrown away as waste. In most plants, it is often a question whether the tonnage of such by-products is sufficiently worth while.

Possible Fields for Research.—Possible lines of research on special sands naturally group themselves under two heads: preparation and utilisation. As regards preparation there is ample room for the study of efficient methods of washing, screening, and drying. The best methods for these different processes have not yet been found for all conditions. The common practice is, of course, the usual procedure of adoption of methods and equipment that have been used in the given district. Preparation studies would also include investigation of possible uses and possible treatment of present waste products at sand plants, either as special sands or the waste products from the preparation of certain sands. Studies in the utilisation of special sands would probably best be devoted to methods of testing physical properties for suitability for special uses, with possibly some effort given to finding new uses. This latter, however, is believed to be of secondary importance. Specific problems that suggest themselves are the relative advantages of sands of round and of angular grain for different abrasive uses; a method of determining the toughness or durability of abrasive sands; a method of determining the abrasive value of sands; and the relative advantages of a closely sized and unsorted sand for certain abrasive purposes. A more rational method of defining the size and grading of filter sands ought to be devised, although the present method is very firmly established by usage among sanitary engineers. The sand producer, however, would welcome a more direct method. These and many other special problems make an interesting field for investigation.

Viscosity of Clay Slips

Effect of Various Agents

In proportion to the reduction in viscosity of a clay slip, a corresponding increase in the degree of purification is attained, and this is accomplished by various agents. Water alone does not purify clay as satisfactorily as when the latter is mixed with dilute solutions of electrolytes, which cause the clay particles to remain in suspension whilst the coarser particles settle out. When water is employed without the aid of electrolytes the amount of clay held in suspension is very low, part of it being carried down by the particles of coarse material. Experiments on the viscosity of clays have demonstrated that twice as much clay can be separated from the raw material when electrolytes are employed as when the latter are dispensed with and water alone used. The action of various alkaline salts increases the state of dispersion in the system, breaking up the larger particles into those of smaller dimensions. A stiffening of the mass occurs when there is excessive concentration, and consequently a decrease in alkalinity takes place. The effect of time on mixtures of high alkaline concentration changes their viscosity less than it does with mixtures of lower concentration.

The presence of such salts as aluminium chloride makes the liquid less susceptible to the influence of deflocculating agents. The presence of organic colloids in a liquid also renders it less liable to be affected by deflocculating agents. As clay slips absorb a large volume of air, the effect being particularly noticeable in the case of certain kaolins, thorough stirring is advisable prior to determining their viscosity. Subjecting the slips to a vacuum is frequently resorted to in order to release this confined air. Absorption of the reagents has an important effect on viscosity, kaolins differing greatly in regard to the change effected by the various agents employed. Sodium silicate and sodium hydroxide are more readily absorbed by kaolins and are consequently more effective in reducing their viscosity than sodium carbonate, possessing a wider range of action than the latter. As the viscosity of a clay slip is a particularly important factor influencing the rate of sedimentation, the determination of its viscosity is more satisfactorily accomplished when an efflux viscometer is used. The viscosity of separate clays is no criterion of the viscosity of two or several of these clays in combination, since the impurities existing in either may occasion reactions in combination very dissimilar to those occurring when treated singly. For instance, the length of time occupied by an English China Clay combined with an American kaolin to pass through a viscometer might probably be double or even treble that occupied by the same clays tested separately.

China Clay Notes and News

Ball Clay Trade Brisker

As many claycutters in Newton Abbot ball clay district have been restarted, the unemployment figures decreased last month from 237 to 167.

China Clay from Czecho-Slovakia

During the nine months ended September, 1925, exports of China Clay from Czecho-Slovakia amounted to 178,917 metric tons, showing an increase of 51,469 metric tons when compared with the corresponding period of the previous year.

China Clay Merchant's Widow Leaves £23,000

The late Mrs. Harriet Ann Lovering, of Cosgarne, St. Austell, wife of Mr. John Lovering, China Clay merchant (senior partner in the firm of Messrs. John Lovering and Co.), left £22,999, with net personalty £17,625. In her will she left £600 a year to her husband until he shall again marry, and the residue of the property in trust for her sons John Stephens and Cecil Downing and their children.

China Clay Worker's Protest

A China Clay worker writes: "I beg to state on behalf of my fellow workers with reference to a statement which appeared in a St. Austell paper to the effect 'That the Clay workers were ready to strike in common with others who did so,' that such a statement is a cruel fabrication, and misrepresents the Clay workers as a body of men. Much of the strife in the industrial world is often caused not by the men themselves, but by wild statements made by paid agitators, sowing the seeds of discontent."

Cornish Geologists in Clay District

Roche, near St. Austell, has been visited by the members of the Royal Cornwall Geological Society and the felspar works at Trezaise Downs inspected. The President, Mr. F. J. Stephens, of Camborne, gave a history of Roche Rock and the chapel, and the geological features were pointed out by Mr. J. M. Coon, St. Austell. The members proceeded to Belowda Beacon, and under the guidance of Captain Tippett inspected the adit to prospect the load. The return journey was broken at St. Columb Road to inspect a quarry showing calc-flints. The arrangements for the tour were made by the Secretary, Mr. E. H. Davison.

Well-known Cornish Sportsman's Death

There passed away at St. Austell last month Mr. W. F. Rowe, the well-known sportsman, at the age of 52. He was the brother-in-law of Mr. Martin F. Hitchins, a managing director of English China Clays, Ltd. Mr. Rowe was a very keen footballer, and had been honorary secretary of the Cornwall County Football Association for 21 years. He was also a prominent Freemason, having been a member for many years of Peace and Harmony Lodge 496, of which he had been Worshipful Master, and of which he was the honorary treasurer at the time of his death. He was also a member of the Mt. Edgecumbe Chapter of Royal Arch Freemasons. He had held Provincial Honours, having been Director of Ceremonies and Junior Grand Warden. At his funeral there was a very large attendance of Freemasons and football friends.

Fowey Jettyman Striker's Family

Mr. T. M. Hocking, Relieving Officer, reporting to the St. Austell Board of Guardians, said he had had only two cases to deal with arising out of the strike. One was that of the family of a Fowey jettyman who said he was on strike against his own inclination. He ascertained from the G.W.R. that if a large number of men came back at the jetties the man could not be given work because of the lack of railway transport. He visited the home of the man, where he found that the wife and six or seven children had no food in the house, the only money the man had received in the week being 15s. for one day's pay. He therefore came to the conclusion that relief ought to be given to the wife and children, and gave an order for 20s. in kind.

Mr. F. Venner: "Was not that a case of lock-out and not strike? Mr. Hocken: "I cannot answer that."

Mr. J. H. Mitchell: "They come under the heading of victims of the strike."

Rare Plymouth Porcelain

To the beautiful collection of Plymouth and Bristol Porcelain which Mr. A. Hurdle has lent to the Plymouth Museum has just been added by him a very rare and probably unique teapot. It has a ground of canary yellow on which are painted floral sprays in the Japanese style. A fairly large amount of this canary ground was produced at Worcester and other eighteenth century English factories, and it was much prized by collectors; but it is believed that Mr. Hurdle's teapot is the only one of its kind in existence. The Plymouth mark in gold is on the bottom of the piece, which is a remarkably fine example from every point of view, and well worthy of a place in any great collection of early English porcelain. Already quite a large number of collectors have visited the Museum to examine this charming fictile production, and all are loud in their praise of its beauty. It seems a very fitting thing that the museum should be able to show all the best productions of Cookworthy, the discoverer of China Clay for china ware. Plymouth has reason to be proud of its townsman, the inventor of hard-paste porcelain in England.

Purification of Clay

Clay may be purified by treatment with a plurality of water-soluble reducing agents acting in presence of one another, according to a patent, No. 18,837/24, in the name of W. Feldenheimer, 20, Holborn Viaduct, London, E.C. The reagents mentioned are sodium sulphide, oxalate, sulphite, bisulphite, metabisulphite, hyposulphite and thiosulphate, calcium sulphide dissolved in alkali carbonate solution, potassium sulphite, sulphurous acid and oxalic acid. Examples describe the treatment of clay with oxalic acid and sodium thiosulphate; oxalic acid and sodium sulphide; oxalic acid, sodium sulphide and sodium thiosulphate; calcium sulphide dissolved in sodium carbonate solution, and sulphurous acid. The treatment may be so conducted as to effect also a purification by deflocculation; for instance, the clay may be deflocculated by sodium sulphide or oxalate with or without a compatible additional deflocculator such as sodium pyrophosphate or some oxalic acid, and after separation of the undeflocculated matter, the slip is then treated with the second reducing agent such as oxalic acid.

China Clay Merchant's Daughter Married

A large congregation assembled in St. Austell Parish Church on June 1 on the occasion of the marriage of Mr. Donald Ross Carter, second son of Mr. J. P. Carter, of Tower Park, Fowey, and Miss Kitty Martin Hancock, younger daughter of Mr. E. J. Hancock, Bay House, St. Austell. The bridegroom is well-known at Fowey, and is engaged in his father's shipbroking firm of Toyne, Carter and Co., Ltd., the well-known China Clay shipping charterers. Miss Hancock has been associated with her father, Mr. E. J. Hancock, in his business as a China Clay merchant; he is the managing director of West Carclaze China Clay Co., Ltd., among other China Clay companies. Miss Hancock was formerly a member of the St. Austell Amateur Operatic Society and took prominent parts in one or two of the Society's performances of Gilbert and Sullivan opera.

The bride was given away by her father, the bridegroom being attended by Mr. J. L. Toyne as best man. The marriage ceremony was performed by the Rev. Walter Cresswell, Vicar of Milton Abbas (Dorset), a friend of the bridegroom. The Rev. E. Roberts (vicar) officiated in the closing stages of the service.

St. Austell Vicar on Strike Lessons

In the St. Austell Parish Church on Whit Sunday, the vicar, the Rev. E. Roberts, said if they believed in God they had a guarantee for progress, not for progress unbroken by retrogression, for the recent strike in a way was retrogression and yet made for progress in the long run. But that guarantee for progress was not an unqualified one, for God delighted to teach this lesson ever—that this success depended upon their endeavour. They had just emerged from a great industrial upheaval, and by studying history they found that Divine Providence called them after every upheaval to new and better endeavours on the road to progress, for every fresh experience brought new lessons. In that sense the recent strike might turn out to be a blessing in disguise. One of the lessons

of the recent upheaval was the realisation that religion was the basis of a happy and progressive life. So many people were obsessed by the idea that all the world needed was a better political and social structure—an improvement in man's outward surroundings. But there was a universal law that reformation must begin from within. We required, not better government and better environment only, but a moral change in the life of the people. The supreme need of the world was the recognition of the sacredness of man and of a new birth of love in the hearts of men for each other.

China Clay Merchant Married

A wedding was solemnised at St. Saviour's Church, Ditchling Road, Brighton, on June 2, between Miss Evelyn Grace Furze, youngest daughter of Mr. and Mrs. R. H. Furze, of "Luttleworth," Ditchling Road, Brighton, and Mr. Samuel Percival Dyer, eldest son of Mr. Samuel J. Dyer and the late Mrs. Dyer, of Claybourne, St. Austell. There was a large congregation present and the service was fully choral. Mr. Gordon Nicholls, of St. Austell, carried out the duties of best man. A reception followed at "Luttleworth," the bride's home, where Mr. and Mrs. Furze entertained over 60 guests, who included several members of the bridegroom's family from Cornwall, among others the bridegroom's father, Mr. S. J. Dyer, who is well known in the district as a China Clay merchant; Mrs. T. Leigh, of Rosevear, Bugle (sister of the bridegroom); Captain and Mrs. Fred Dyer, of St. Dennis (uncle and aunt of the bridegroom). Later in the day Mr. and Mrs. Percy Dyer left for Bournemouth, where they spent their honeymoon.

Considerable interest has been evinced in the event in the St. Austell China Clay district, where the bridegroom is well known. He is secretary of the Imperial Goonbarrow and the Rosevear China Clay Companies, and also assists his father in the administration of other works. Mr. Dyer is also a member of the St. Austell Fire Brigade.

St. Austell Bank Manager's Retirement

Mr. E. T. Hamilton has retired from the management of Lloyd's Bank, St. Austell, where a large number of China Clay merchants have come into contact with him and have learned to appreciate his impartiality, courtesy and patience. Mr. Hamilton commenced his banking career in the town where he has brought it to a close, for he started with the old Devon and Cornwall Bank (afterwards Lloyd's), at St. Austell, 47 years ago. Afterwards he had experience in London, then in North Devon, coming from Redruth to take up the management at St. Austell in May, 1903, following the death of his predecessor, Mr. Gill, whom he had previously succeeded in Redruth. Shortly after the amalgamation with the Capital and Counties Bank during the war, Lloyd's moved from their premises (now occupied by Varcoes China Clays, Ltd.) into the Capital and Counties Bank premises, Mr. Hamilton assuming the sole management after the death of his joint colleague Mr. Cornish, the former manager at the Capital and Counties Bank.

During the financial distractions and industrial uncertainties of the war and after, the lot of a bank manager has been by no means an enviable one, the responsibility of reconciling customers' requirements with the sometimes inelastic policy of the Bank's headquarters being very much greater than is generally supposed. That Mr. Hamilton maintained the equilibrium so well under very difficult circumstances is at once a tribute to his interest in the customer and his concern for the interests of the Bank of which he has been such a trusted servant for so many years.

The Strike: Clay Workers Summoned

There was an echo of the general strike when four young China Clay workers—William and George Parnell, of Modbury, Reginald Steer and Thornton Whitford, of Cornwood, appeared before the Devon magistrates at Plympton, summoned for doing malicious damage to the extent of £1 2s. to the property of the Ivybridge China Clay Company.

Mr. E. E. Square, prosecuting, said that in consequence of the general strike the company had to stand their men off because there was difficulty in getting coal and other materials through to Redlake. The defendants appeared to have taken the information quite well when the foreman told them, but no sooner was his back turned than they went round the place doing what damage they could. There was direct evidence that William Parnell broke up a tent pole and did damage to a pipe, that Whitford broke a shovel handle and drove a pick through a shovel blade, and also bent a pipe, but the damage done by these two, and possibly the other two, who were with them, was considerable and of greater value than was set out. Two picks were missing, though one had since been found damaged, and the shaft thrown away; tram rail dogs had been pulled out, causing a truck to overturn; and numerous other dogs were pulled out of the rails and thrown all over the moor and into the water of the pit. More damage was done than could be estimated in shillings and pence.

"What good these men thought they were doing for themselves I don't know," Mr. Square added. "It means they had to be brought here as a matter of discipline; they will never get their jobs back again and they will have to answer here for damage which might lead to very serious consequences for them."

Richard Thomas Sweet, foreman, of Ivybridge, gave evidence, and Albert Dymond, of Lee Mill Bridge, described seeing the four defendants going about together, and said he saw William Parnell bend a pipe and Whitford put a pick through a shovel. They afterwards went in the direction of the tram rails.

Expressing the view that there was no direct evidence against them, the Bench dismissed the charges against George Parnell and Reginald Steer. William Parnell and Thornton Whitford were fined £1 each, Major Strode, the Chairman, remarking that the Magistrates had leniently dealt with them because they took the view that defendants did not deliberately go out to do damage but did the mischief after they had been turned off.

China Clay Pioneer's Death

We regret to record the death of Mr. W. W. R. Nicholls, of Penair House, St. Austell, at the age of 72, after a trying illness patiently borne. Much sympathy is expressed for his widow and two daughters who survive him. Mr. Nicholls and his forbears played a conspicuous part in the development of the China Clay industry, and Mr. Nicholls himself was engaged in the industry all his life, and in his early days travelled abroad on behalf of the firms in which he was interested. Until he explored the possibilities of China Clay in North Cornwall some twenty-three years ago, the prevailing opinion was that China Clay development on a large scale must be confined to Mid-Cornwall. Despite many drawbacks, among them the landowners' indisposition to favour industrial development and the remoteness of the district from railways and ports, Mr. Nicholls persevered, and having proved the existence of extensive deposits in the neighbourhood of St. Breward, got financiers interested in it. He was largely responsible for the formation of the North Cornwall China Clay Co., which undertook the initial development. Its subsequent development under the supervision of Mr. Walter Sessions and its later amalgamation with the West of England China Clay Co. in English China Clays, Ltd., is a matter of recent history.

Mr. Nicholls was a giant in stature, and was probably the biggest man in St. Austell. He was of a retiring disposition, and took little active interest in the public affairs of the town or in the organisations connected with the China Clay industry. His main interest outside his business was in the Wesleyan Church, he having been a Methodist from childhood. In addition to his own business as a China Clay merchant, Mr. Nicholls was a director of North Goonbarrow China Clay Co., Ltd., with whose works the Nicholls family have been associated for generations. At the funeral Messrs. H. and W. T. Nicholls were the family mourners.

Amongst those who followed were: Messrs. E. H. Richards, R. M. Richards, S. J. Dyer, J. Hooper, S. Benson, W. Williams, E. Goodman, F. Hart, T. Powell, W. H. Lake, W. Hore, S. P. Bunn, G. P. Bunt, J. Pascoe, W. J. Cock, S. Martin, Inspector Trythall, Messrs. W. H. Snell, H. Jenkin, J. A. Cumberledge, J. H. Treloar, W. Mutton, F. R. O. Mewton, W. G. Hawken, P. S. Keene, J. H. Dingle, W. W. Woolcock, F. S. Liddicoat, Stanley Parsons, F. A. Coon, Edgar Williams (secretary, North Goonbarrow), J. Keast, W. W. Piper, Captain C. Thomas (North Goonbarrow), A. Phillips (Tywardreath), T. W. Couch, C. Selleck (Hallaze). The bearers were friends and fellow workers with deceased in the Wesleyan Church: Messrs. W. Wedlake, J. W. Hoskin, J. Armstrong, W. G. Golley, W. Lawry, A. Trethewey.

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay with countries of destination, and other shipping and export matters are dealt with.

Charlestown Shipping—May, 1926

Arrivals

Date.	Vessel.	From
May 1	*Treleigh*	Portreath
May 4	*Steiermark*	London
May 4	*Conrad Luhring*	Poole
May 4	*Britisher*	Poole
May 6	*Henrich Luhring*	Exmouth
May 11	*Aran Island*	Plymouth
May 11	*La Revanche*	Nantes
May 12	*Irish Minstrel*	Falmouth
May 13	*Happy Harry*	Falmouth
May 15	*Wellington*	Fowey
May 15	*Greta*	Padstow
May 16	*Karnten*	Poole
May 19	*Kate*	Porthoustock
May 24	*Pet*	Cardiff
May 30	*Marta*	Pontrieux (France)
May 31	*C. and F. Nurse*	Truro

Sailings

Date.	Vessel.	Destination.
May 1	*Miriam Thomas*	Liverpool
May 1	*Wans Fell*	Tayport
May 3	*Treleigh*	Preston
May 4	*Jantze Grunefeld*	Christianssand
May 4	*Britisher*	London
May 7	*Conrad Luhring*	Kotka (Finland)
May 8	*Steiermark*	Terneuzen
May 8	*Henrich Luhring*	Kotka (Finland)
May 12	*Aran Island*	Rouen
May 14	*Katie*	London
May 14	*Irish Minstrel*	Rochester
May 15	*La Revanche*	Nantes
May 15	*Happy Harry*	Newcastle
May 16	*Karnten*	Antwerp
May 17	*Greta*	Karlstad Gothesburg
May 28	*Kate*	London (Gravesend)

Fowey Shipping—May, 1926

Arrived.	Name.	Sailed.	Destination.
May 1, S.S.	*Newton Ash*	May 26,	Philadelphia
May 1, S.S.	*Ruth*	May 2,	Par
May 1, S.S.	*Guelder Rose*	May 2,	Preston
May 1,	*Triumph*	May 7,	Plymouth
May 1, S.S.	*Halton*	May 19,	Birkenhead
May 1, S.S.	*Marta*	May 5,	Dunkirk
May 2, M.V.	*Kurt*	May 11,	Hamburg
May 2, S.S.	*Rubfred*	May 20,	Oscarshamn
May 2, S.S.	*Birmingham*	May 18,	Manchester
May 2, M.V.	*Wirumaa*	May 6,	Reval
May 2, M.S.	*Estrella*	May 29,	San Francisco
May 3,	*Trio*	May 7,	Rotterdam
May 4, S.S.	*Conistone*	June 5,	Portland, Me.
May 4, S.S.	*Taxandrier*	May 10,	Cape Race
May 4, S.S.	*Oswal*	June 5,	Boston, Mass.
May 5, S.S.	*Hill Glen*	May 29,	Montreal
May 5, M.V.	*William Ashburner*	May 25,	London
May 5, S.S.	*Katherine*	May 7,	Pentewan
May 5, S.S.	*T. P. Tilling*	May 28,	Weston Point
May 7, S.S.	*Lotharingia*	May 7,	Cherbourg
May 7, S.S.	*Calcaria*	May 19,	Dieppe
May 8,	*Scotia*	May 15,	Pentewan
May 9, M.S.	*Skoghall Sverken*	May 21,	Fredrickshald
May 9, M.V.	*Lynher*	May 8,	Pentewan
May 10, M.V.	*Hope*	May 14,	Plymouth
May 14, M.V.	*Shamrock*	May 14,	Plymouth
May 14, M.V.	*Lynher*	May 15,	Plymouth
May 17, S.S.	*Horn*	May 22,	Riga
May 18, S.S.	*Gasconier*		*
May 19, S.S.	*Westdale*	May 22,	*
May 19, M.V.	*Hope*	May 21,	*
May 20, M.V.	*Lynher*	May 26,	Plymouth
May 21, M.V.	*Grandes Dalles*	May 22,	Paimpol
May 21, S.S.	*Vechtstroom*	May 29,	Amsterdam
May 21, S.S.	*Rose*	May 26,	Lancaster
May 21, S.S.	*Urpeth*	June 1,	Brussels
May 21,	*Trevellas*	June 7,	Erith
May 22, S.S.	*Gylfe*	June 3,	Wargon
May 22, S.S.	*Whinhill*	May 28,	Liverpool
May 22, M.V.	*Harjumaa*	June 3,	Helsingfors
May 22, S.S.	*Siva*	June 1,	Hamburg
May 23, S.S.	*Lita*	June 3,	Antwerp
May 23, S.S.	*Fellside*	June 5,	Brussels
May 24, M.V.	*Lydia Cardell*	May 29,	Par
May 24, M.V.	*Hope*	May 25,	Par
May 25, M.V.	*Theodora*	May 26,	Par
May 26, S.S.	*Kirkwynd*	June 5,	Rouen
May 26,	*Pecheuse*	*	La Pallice
May 28, S.S.	*Texelstroom*	*	Amsterdam
May 28, M.V.	*William and John*	May 29,	Charlestown
May 29, M.V.	*Oceaan*	*	Antwerp
May 30, M.V.	*Erika*	June 7,	Reval
May 30, S.S.	*Avdgarvel*	June 5,	Antwerp
May 30, S.S.	*Keltier*	*	Philadelphia
May 31, S.S.	*Mosjau*	June 7,	Bo'ness

* In port.

Par Harbour Shipping—May, 1926

Sailings

Date.	Vessel.	Destination.
May 1, S.S.	*Alice*	Antwerp
May 2, S.V.	*Pearl*	Runcorn
May 3, S.S.	*Guardian*	Antwerp
May 4, S.V.	*S. F. Pearce*	Antwerp
May 4, S.V.	*Two Sisters*	Antwerp
May 4, S.V.	*Penryn*	Queenborough
May 6, S.S.	*Tanny*	Barry
May 9, S.S.	*Ruth*	Pentewan
May 10, M.V.	*Diligent*	Mevagissey
May 11, S.S.	*Magrix*	Dieppe
May 11, M.V.	*Jupiter*	Gravelines
May 14, S.V.	*Pedestrian*	Penarth
May 18, S.V.	*Lady Daphne*	Rochester
May 18, S.V.	*Triumph*	Plymouth
May 21, M.V.	*Airston*	London
May 25, M.V.	*Hope*	Fowey
May 26, S.V.	*Western Lass*	Gravelines
May 27, S.V.	*Waterwitch*	Grimsby
May 28, S.S.	*Annchen Peters*	Gotenburg
May 29 S.V.	*J.N.R.*	Plymouth
May 31, S.V.	*Fanny Crossfield*	Leith
May 31, S.V.	*Ryelands*	Rochester
May 31, M.V.	*Hope*	Plymouth

Arrivals

Date.	Vessel.	From
May 1, S.S.	*Ruth*	Barry
May 2, S.V.	*Fanny Crossfield*	Newhaven
May 4, S.S.	*Tanny*	Hayle
May 5, M.V.	*Diligent*	Plymouth
May 5, S.V.	*Lady Daphne*	Truro
May 8, S.S.	*Magrix*	Teignmouth
May 17, S.V.	*Western Lass*	Falmouth
May 17, S.V.	*Waterwitch*	Porthoustock
May 17, S.V.	*Triumph*	Charlestown
May 19, M.V.	*Airston*	Plymouth
May 19, M.V.	*Isabel*	Mevagissey
May 20, S.V.	*Mary Ann Mandall*	Totnes
May 21, S.V.	*J.N.R.*	Plymouth
May 22, S.S.	*Annchen Peters*	Southampton
May 22, S.V.	*Alf Everard*	Exmouth
May 23, S.V.	*Ryelands*	Falmouth
May 25, M.V.	*Hope*	Fowey
May 28, M.V.	*Lydia Cardell*	Fowey
May 29, S.S.	*Magrix*	Teignmouth

Par Harbour Tide Table, July, 1926

(*British Summer Time throughout.*)

Day of week.	Day of Month.	Morning.	Afternoon.	Height.
Thursday	1	10.22	10.48	11.10
Friday	2	11.15	11.43	11.4
Saturday	3	—	0.13	10.11
Sunday	4	0.45	1.19	10.9
Monday	5	1.53	2.27	11.0
Tuesday	6	3.0	3.32	11.4
Wednesday	7	4.3	4.32	11.8
Thursday	8	4.59	5.25	11.11
Friday	9	5.50	6.14	12.1
Saturday	10	6.36	6.57	12.1
Sunday	11	7.17	7.36	12.1
Monday	12	7.54	8.11	12.0
Tuesday	13	8.27	8.43	11.9
Wednesday	14	9.0	9.17	11.5

Day of week.	Day of Month.	Morning.	Afternoon.	Height.
Thursday	15	9.33	9.50	11.1
Friday	16	10.8	10.27	10.9
Saturday	17	10.47	11.8	10.4
Sunday	18	11.31	11.56	10.1
Monday	19	—	0.24	9.11
Tuesday	20	0.55	1.29	10.0
Wednesday	21	2.51	2.40	10.5
Thursday	22	3.14	3.46	11.1
Friday	23	4.16	4.45	11.11
Saturday	24	5.13	5.40	12.7
Sunday	25	6.7	6.33	13.2
Monday	26	6.59	7.24	13.4
Tuesday	27	7.48	8.11	13.7
Wednesday	28	8.33	8.56	13.6
Thursday	29	9.19	9.42	13.1
Friday	30	10.5	10.28	12.6
Saturday	31	10.51	11.15	11.9

E. CLEMENS, Harbour Master.

China Clay Exports for May, 1926

A RETURN showing the exports of China Clay, the produce or manufacture of the United Kingdom, from the United Kingdom to each country of destination registered during the month ended May 31, 1926 :—

COUNTRY OF DESTINATION.	CHINA CLAY. QUANTITY. Tons.	VALUE. £
Russia	240	400
Finland	709	1,105
Estonia	401	390
Latvia	574	715
Sweden	2,925	6,221
Norway	2,019	3,351
Germany	2,263	4,935
Netherlands	3,533	7,884
Belgium	4,060	6,467
France	2,504	4,760
Spain	890	1,825
Italy	498	1,373
United States of America	30,286	59,168
Mexico	475	1,940
Peru	10	46
Brazil	51	193
Argentine	15	102
Bombay, via other Ports	2,350	9,802
Madras	178	605
Bengal, Assam, Bihar and Orissa	304	856
Australia	10	59
Canada	80	243
Irish Free State	2	2
Total	54,377	112,442

Young Barrister's Marriage

AT St. Peter's Church, Treverbyn, on Tuesday, June 1, a wedding of great interest was solemnised in the presence of a crowded congregation, the vicar (the Rev. Hugh J. Sweeney) officiating. The bridegroom was Mr. A. P. Marshall, the son of Mr. and Mrs. A. E. S. Marshall, Park Villa, Roche, and the bride Miss Meta Hawke, L.G.S.M., younger daughter of Mr. and Mrs. W. Hawke, of Bugle. The bridegroom's father is interested in the China Clay industry, being associated particularly with the Great Wheal Prosper China Clay and Stone Co., Ltd. Mr. and Mrs. Marshall are taking up their residence at Bournville, Birmingham, where Mr. Marshall is practising as a barrister. The bridegroom was President of the Cambridge Union for 1924, and the bride is a very well-known vocalist, who has achieved considerable success in training the young people of Bugle, her concert parties having been very popular, and successful in raising hundreds of pounds for the churches and institutions of Mid-Cornwall.

Strike Seriously Affects May Deliveries

Drop in Five Months Nearly 25,000 Tons

IN consequence of the general strike we were unable to obtain the statistics of China Clay, China Stone, and ball clay deliveries in April for publication in our last issue. They are therefore given below, together with the figures for May and comparisons with the corresponding periods of 1925. It will be seen by the figures that April was a good month and came within a couple of hundred tons of March, which again was slightly below February. The general strike, and latterly the coal strike, proved, after all, a serious set-back to trade during May, despite the strenuous efforts made to make up the leeway after the ten days' general strike. Fowey shows a total drop of over 30,000 tons, nearly 29,000 tons of which was in respect of China Clay, and Par showed a drop of 1,600 tons, Charlestown being the only port that showed an increase—nearly 500 tons. This was due to the fact that this port worked continuously throughout the strike. The drop in the May returns has affected the total trade for the five months, though not by so much as the drop on the month. The net drop for the five months, compared with the corresponding months of last year, is 24,918 tons. Taking the individual classes, there was an increase of 559 tons in ball clay and 606 in China Stone. The drop in China Clay was 25,232.

APRIL DELIVERIES.

Port.	China Clay. 1926	China Clay. 1925.	China Stone. 1926.	China Stone. 1925.	Ball Clay. 1926.	Ball Clay. 1925.	Total. 1926.	Total. 1925.
	Tons.		Tons.		Tons.		Tons.	
Fowey ..	62,525	45,713	2,272	2,395	1,671	1,118	66,468	49,226
Par	4,409	4,040	656	793	—	—	5,065	4,833
Charlestown ..	3,682	3,646	—	—	—	—	3,682	3,646
Plymouth ..	1,793	1,248	—	10	—	—	1,793	1,258
Falmouth ..	1,572	110	—	—	—	—	1,572	110
Penzance ..	1,252	330	—	—	—	—	1,252	330
Porthleven ..	—	120	—	—	—	—	—	120
Newham ..	—	—	151	—	—	—	151	—
By rail	3,889	4,417	—	—	—	—	3,889	4,417
April ..	79,122	59,624	3,079	3,198	1,671	1,118	83,872	63,940

MAY DELIVERIES.

Fowey ..	33,731	66,782	1,118	3,950	1,412	1,765	36,261	72,497
Par	3,313	2,943	120	326	—	—	3,433	3,269
Charlestown ..	4,109	4,994	—	—	—	—	4,109	4,994
Plymouth ..	287	1,614	—	10	—	60	287	1,684
Penzance ..	250	345	—	—	—	—	250	345
By rail	3,889	4,182	—	—	—	—	3,889	4,182
May	45,579	80,860	1,238	4,286	1,412	1,825	48,229	86,971
April ..	79,122	59,624	3,079	3,198	1,671	1,118	83,872	63,940
March ..	79,393	94,217	5,333	2,526	1,224	1,855	85,950	98,598
February ..	81,331	66,986	3,166	3,436	1,558	614	86,055	71,036
January ..	66,520	75,490	3,742	2,506	3,156	3,050	72,567	81,046
Totals, 5 Months	351,945	377,177	16,558	15,952	9,021	8,462	376,673	401,591

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act of* 1908 *provides that every Mortgage or Charge, as described therein, shall be registered within* 21 *days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.*]

ANGLESEY BRICK AND TILE CO., LTD., Llanbedr.—Registered May 28, £2,000 debentures (filed under Section 93 (3) of the Companies (Consolidation) Act, 1908), present issue £1,000 ; general charge.

BRITTAINS, LTD., Hanley, paper manufacturers.—Registered May 27, £5,000 debentures, part of amount already registered ; general charge. *£55,000. March 30, 1926.

REDHILL TILE CO., LTD.—Registered May 29, £100 and further advances not ex. therewith £800 mortgage, to T. Cotching, Horsham, solicitor ; charged on properties in Honeycrook Lane, Salfords, Horley. *£4,500. July 17, 1925.

Satisfaction

KINGS NORTON BRICK CO., LTD.—Satisfaction registered June 1, £16,000, registered November 9, 1920, and collateral mortgage registered November 13, 1920.

China Clay Imports for May, 1926

A RETURN of the registered imports of China Clay, including China Stone, into Great Britain and Northern Ireland during the month of May, 1926, indicates that the imports were nil.

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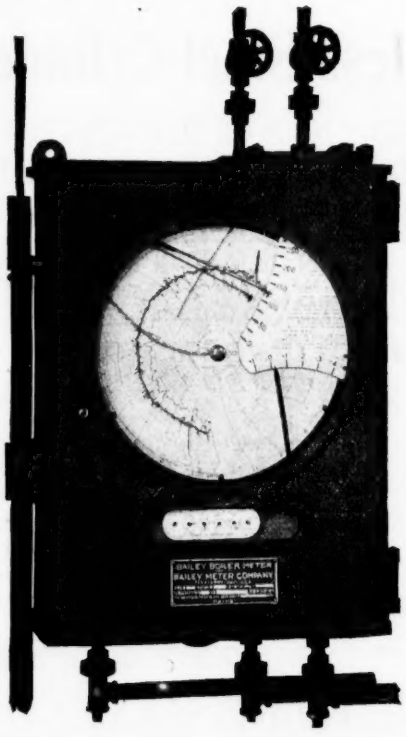

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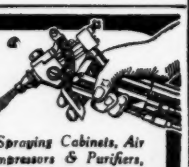

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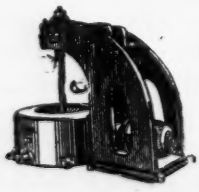

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1 Gas Muffle Furnace, 2 ft. 3 in. by 1 ft. 10 in. by 1 ft. 7 in.
1 Air and Gas Compressor, complete with cylinder and gauge.
1 Hydraulic Baling Press, by Shaw, table 5 ft. by 3 ft.; ram 22 in. diameter.
2 Hydraulic Baling Presses, by Fauset Preston, table 3 ft. 4 in. by 2 ft. 6 in.; ram 14 in. diameter.
—Apply H. D. DOUGLAS AND CO., LTD., 7, Victoria Street, S.W.1.

Miscellaneous Wants

ANY Manufacturing Chemist desirous of developing new lines can have methods of actual manufacture of some first-class lines, with some supervision if desired, and all necessary information by consulting expert. Moderate charges.—Write, if possible, stating what class of business is desired to BOX 786, THE CHEMICAL AGE, Bouverie House, Fleet Street, E.C.4.

GRINDING of every description of chemical and other materials for the trade, with improved mills.—THOS. HILL-JONES, LTD., "Invicta" Mills, Bow Common Lane, London, E. Telegrams: "Medikaster, London." Telephone: 3633 East.

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WANTED.—Radium Salt, Pure or Residues, Old Applicators, &c. —Apply, HARRISON GLEW, Radium Laboratories, 156, Clapham Road, S.W.9.

Situation Vacant

CHEMICAL Engineering Managing Director required to take place of one retiring on account of health; well-established business; salary to competent person £750 to £1,000 per annum; investment of £4,000 required in shares of present Director.—Reply Waller and Co., 3 and 4, Clement's Inn, Strand, W.C.2.

Patents and Trade Marks

KING'S PATENT AGENCY, LTD. (B. T. King, Registered Patent Agent, G.B., U.S., and Can.), 146A, Queen Victoria Street, London, E.C.4. Advice Handbook and Cons. free. 40 years' refs. 'Phone Cent. 682.

MANUFACTURE OF HYDROGEN AND OXYGEN. The owners of British Patent No. 210,102 desire to dispose of the same or would grant a licence to work the invention on royalty terms.—Particulars may be obtained from TECHNICAL RECORDS, LTD., of 59–60, Lincoln's Inn Fields, London, W.C.2.

THE Proprietors of Letters Patent Nos. 179,096 and 183,348, relating to Methods of Producing Hydrocyanic Acid, desire to dispose of their Patents or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring their full commercial development and practical working in this country.

Enquiries to be addressed to CRUIKSHANK AND FAIRWEATHER, Chartered Patent Agents, 65/66, Chancery Lane, London, W.C.2.

THE Proprietors of Letters Patent No. 151,583, relating to Method of Producing Cyanamide from Calcium Cyanamide, desire to dispose of their Patent or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.

Enquiries to be addressed to CRUIKSHANK AND FAIRWEATHER, Chartered Patent Agents, 65/66, Chancery Lane, London, W.C.2.

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

THE Proprietors of British Patent No. 164627 are prepared to sell the patent or to license British manufacturers to work thereunder. It relates to lead chambers for the manufacture of sulphuric acid. Address:
B. W. AND T.,
112, Hatton Garden, London, E.C.1.

THE Proprietors of Letters Patent No. 200,090, relating to Method of and Apparatus for Sintering Ores, desire to dispose of their Patent or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.

Enquiries to be addressed to CRUIKSHANK AND FAIRWEATHER, Chartered Patent Agents, 65/66, Chancery Lane, London, W.C.2.

Miscellaneous Announcements

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Patents—*continued*

THE owners of British Patent No. 131,314 for match-making machines, and British Patent No. 183,814 for conveying devices for match-making machines, are desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the above inventions either by sale of the Patent rights or by the grant of a licence or licences to manufacture on royalty. Inquiries should be addressed to MESSRS. ABEL AND IMRAY, 30, Southampton Buildings, London, W.C.2, who will be pleased to send copies of the specifications on request.

THE Proprietors of Letters Patent No. 185,859, relating to Improvements in or relating to the Treatment of Matte and other Materails and Solutions containing Copper and Nickel, desire to dispose of their Patent or to grant licences to interested parties on reasonable terms for the purpose of exploiting the same and ensuring its full commercial development and practical working in this country.

Enquiries to be addressed to CRUIKSHANK AND FAIRWEATHER, Chartered Patent Agents, 65/66, Chancery Lane, London, W.C.2.